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CITY OF BURBANK

Safety Element





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SAFETY ELEMENT OF THE CITY OF BURBANK GENERAL PLAN

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Prepared by the City of Burbank Community Development Department,
Advance Planning Section

Adopted by Burbank City Council on July 1, 1997
Resolution No. 25087

VII. SAFETY ELEMENT

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I. INTRODUCTION

The purpose of this Safety Element is to reduce loss of life, injuries and damage to property as well as economic and social dislocation resulting from disasters. To this end, the Element identifies and evaluates the safety hazards in the City and establishes policies and recommendations to reduce risk. The Element identifies areas where private and public decisions on land use need to be responsive to hazardous conditions.

California Government Code 65302(g) requires that each city have a safety element as one of the seven mandatory elements of the General Plan. The safety element is the primary vehicle for identifying hazards that Burbank must consider when making land use decisions.

The Safety and Seismic Safety Elements joined the state statutes in 1971. The Safety Element was required partly in reaction to devastating wildland fires in September and October 1970. The 1971 San Fernando earthquake was instrumental in prompting the legislature to pass the requirement for a Seismic Safety Element. The City of Burbank has a Safety Element, last adopted in 1972, and a Seismic Safety Element adopted in 1983. In 1984, state law consolidated the Seismic Safety Element requirements with those of the Safety Element and deleted the requirement for adoption of a separate Seismic Safety Element. This Element is an update and consolidation of the Safety and Seismic Safety elements.

This Safety Element is presented in eleven sections. Following this introductory section, Section II summarizes the major findings of the Element and its appendices. Section III gives an overview of Burbank's Emergency Response resources and the Multi-Hazard Emergency Operations Plan which is the backbone of the City's emergency response system. This section briefly describes the critical facilities most threatened by a major disaster; these facilities are also discussed in subsequent sections in relation to specific hazards. Sections IV through IX look at the six major safety hazards which could impact the City: seismic hazard; fire hazard; storm, flood and mudslide hazard; airport accident hazard; hazardous materials incident; and civil disturbance. The most extensive hazard analysis is of seismic hazards resulting from a major earthquake. Earthquake is probably the most likely and most potentially devastating emergency which threatens Burbank. An earthquake has the potential to cause a variety of other hazards such as fire, mudslide, flood and hazardous materials incident. Measures to implement the recommendations and policies detailed in this Element are listed in Section X. The final section, XI, is a glossary of acronyms used in the Element.

II. SUMMARY OF FINDINGS

The findings summarized below are based on information found and discussed in this Safety Element and its appendices.

A. EMERGENCY RESPONSE

1. Burbank has a Multi-Hazard Emergency Operations Plan which provides guidance for City responses to extraordinary emergency situations such as natural disasters and technological incidents. This plan designates appropriate responses on the part of City departments and enlists several private organizations in times of disaster. The Police and Fire departments have been delegated major responsibilities in carrying out the emergency plan.
2. When a major emergency or disaster occurs, the City's Emergency Operations Center (EOC) is activated to coordinate response by staff and representatives from various departments who are assigned emergency management responsibilities in the City.
3. The Burbank Fire Department has direct responsibility for coordinating most disaster response in the City; the Burbank Police assist in many phases of disaster response, especially traffic control and controlling civil disturbances.
4. Burbank has an enhanced 911 Emergency Call System which incorporates a video screen showing the caller's phone number, address and telephone billing name. All 911 calls go to the central police dispatch center where they are screened and then routed according to the type of emergency.
5. Burbank has an excellent response time for local emergencies, averaging about three minutes per call for the past several years.

B. SEISMIC HAZARD

Faults named below can be seen on Figure 7 on page 33.

SEISMICITY

1. Within the next 100 years, an earthquake on the San Andreas fault has the greatest probability of occurring. Earthquake studies indicate, however, that the effect of a San Andreas Fault Magnitude 7.5 earthquake on most cities in the Los Angeles Basin would not be catastrophic, with major damage restricted to isolated pockets throughout the basin. The San Andreas fault was not used for an earthquake scenario in this element because other faults, closer to the City of Burbank, are capable of generating earthquakes that will have a greater impact on the City.
2. An earthquake on the San Fernando fault also has a high probability of occurring in the next 100 years and is likely to generate a Magnitude 6.6 earthquake. Such an event would result in Modified Mercalli (MM) seismic intensities of up to 7.5 in the City of Burbank, similar to those experienced during the 1971 San Fernando Earthquake.
3. A maximum credible earthquake on the Sierra Madre fault would generate seismic MM intensities of up to 8.5 in the City of Burbank; however, studies indicate that this fault has a low probability of generating such an earthquake in the next 100 years.
4. The Hollywood fault, likely to generate a Magnitude 6.4 earthquake, is estimated to have a low probability of occurring sometime within the next 100 years. A worst-case scenario for this event, however, indicates that the southern part of the City may experience MM intensities of up to 10.0.
5. There is no reliable data with which to gauge the probability of a maximum credible earthquake occurring on the Verdugo fault, which lies along the base of the Verdugo Mountains in Burbank. For worst-case planning purposes, it was assumed that the Verdugo and Hollywood faults have similar (low) probabilities of generating a maximum credible earthquake. The maximum credible earthquake on the Verdugo fault has been estimated to be of Magnitude 6.7, resulting in worst-case MM intensities of up to 8.0 in the City.

FAULT RUPTURE

6. The California Division of Mines and Geology and the United States Geological Survey consider the Verdugo Fault Zone a surface rupture hazard. The fault, however, has not yet been recognized as an active fault by the State's Alquist-Priolo Special Studies Zone Act. Future fault investigations near the defined fault traces may establish unequivocally whether this fault meets the conditions necessary to be designated as an active fault. Meanwhile, the fault should be considered active for planning and development purposes, until geologic studies can resolve the issue.
7. Potentially active faults in the valley area of the City are of uncertain seismic risk, posing unique problems when evaluating the acceptable risk of fault rupture. Conventional fault investigation methods may not be applicable to the study of these faults because they are covered by deep layers of sediment. The acceptable risk from these faults is dependent on the sensitivity of the land use or facilities planned for this area.

LIQUEFACTION

8. Studies have shown that liquefiable ground conditions MAY exist in the City of Burbank. The recognized liquefaction-prone areas cover approximately 340 acres: 200 acres along and adjacent to the Los Angeles River, and 140 acres parallel to Interstate 5 (see Plate 1, in rear pocket, and page 55).
9. Site-specific geotechnical investigations should be performed prior to development in areas identified as liquefaction-prone. Areas where water is trapped in sediments at an elevation higher than the regional water table (perched ground water) may pose additional liquefaction hazards. These areas are most commonly found in alluvial basins where flood plain or stream channel deposits predominate (Zones 1 and 3 on Plate 1, in rear pocket).
10. Several methods are available to reduce or eliminate the liquefaction potential of a site, such as replacing the existing soil with nonliquefiable material: emplacing permeable columns of gravel that allow the excessive water pressures that develop in sediment pores during liquefaction to be released, densifying the soil using vibratory compaction

equipment; or lowering the water table with dewatering wells. These can be economically feasible alternatives for structural strengthening and site mitigation for the development of critical facilities, sensitive land uses and some commercial buildings.

SEISMIC VULNERABILITY

11. The threat of dam failure for Burbank's hillside reservoirs (Reservoirs Nos. 1, 4 and 5) is low. A maximum credible earthquake on the Verdugo fault poses the greatest potential threat to these reservoirs, but this earthquake scenario has a low probability of occurring. However, worst-case planning for disaster response should not preclude the possibility of dam inundation; the inundation areas for these reservoirs are shown on Plate 1, in the rear pocket.
12. Hospital facilities built before 1972 are more likely to be damaged during an earthquake than other, more recently built, facilities. Both the Thompson Memorial Medical Center and Saint Joseph Medical Center have pre-1972 buildings. The Verdugo and Hollywood fault earthquake scenarios are those most likely to cause substantial structural and nonstructural damage to the hospitals in the City, including blockage of emergency entrances and exit routes, and loss of critical facilities such as water and power. Liquefaction in areas adjacent to Saint Joseph Medical Center can also affect the function of the facility by disrupting lifelines and utilities.
13. Several freeway structures located in the City of Burbank were identified by the California Department of Transportation (Caltrans) as being in need of seismic retrofit; these were prioritized into two phases of retrofit projects. Caltrans has completed retrofit work on all Phase 1 projects and is scheduled to complete Phase 2 projects by the end of 1997.
14. The malfunction of electrical utilities and the ignition of gas-fired appliances are the principal causes of earthquake-related fires. A major earthquake is likely to result in numerous fires caused by damaged and leaking gas mains, valves and service connections associated with the small-diameter gas supply system. Damage would be concentrated along zones of fault rupture, adjacent to liquefaction zones and in areas that experienced high seismic intensities.

15. Earthquake damage to the large petroleum pipeline crossing the City of Burbank would most likely result in localized ground contamination. The likelihood of fire resulting from such a damaged pipeline depends upon the type of petroleum product being carried in the pipeline. Large natural gas pipelines also cross the City; should these break, there is the risk of explosion and fire. There are also high pressure water lines belonging to the Metropolitan Water District which cross through Burbank; a break in this type of pipeline would result in serious localized flooding.
16. A maximum credible earthquake on the Verdugo or Hollywood faults could seriously disable the major electrical transmission substation located in the western part of the City, near the Burbank-North Hollywood boundary. It could take three days or more to reroute electrical power through other substations and restore power to the City.
17. A maximum credible earthquake on the Verdugo fault would result in a significant reduction in water availability and water pressure due to damaged water lines. Damage would be greatest in areas closest to the fault and in areas of liquefaction. A damage ratio of 0.3 brakes per mile in cast-iron water lines can cause up to an 80 percent deficiency in the flow required to suppress fires.
18. Pre-1934 masonry buildings which have not been retrofitted, and other seismically deficient structures, will most likely be damaged in a large earthquake. The Seismic Safety Commission recognizes several other building types not built to current Uniform Building Code standards which are also at risk. Concerns for potential owner liability and public safety are reasons to address the safety of certain pre-1971 buildings of massive concrete and tilt-up construction, pre-1971 multistory buildings with structural design weaknesses in one or more floors (soft-stories), and buildings with other structural and non-structural hazards. Studies indicate that buildings with deficient plumbing, mechanical and fire features are also potentially hazardous.
19. The City of Burbank has implemented a proactive building safety abatement program aimed at pre-1934 unreinforced masonry buildings. The program established a time line for completion based on the occupancy and risk of the structure which exceeded requirements of the state law. Buildings with masonry-filled walls are not yet covered by the City of

Burbank seismic upgrading ordinance.

20. Figure 1 on page 8 shows, in a generalized way, the seismic vulnerability of selected critical facilities in the City of Burbank. Section IV D presents a more thorough discussion of the seismic vulnerability of Burbank. Figure 2 on page 9 identifies various seismic hazards and the degree of their severity in Burbank, as well as areas of hazard management. These hazards are discussed in detail in Section IV.

EARTHQUAKE HAZARD MITIGATION MEASURES

21. Structural and nonstructural seismic design provisions required for Seismic Zone 4 of the Uniform Building Code, adopted by the City of Burbank, are adequate to mitigate structural hazards if they are enforced and reassessed every three years as required by state law. The Uniform Building Code provides for special fault and liquefaction investigations to be tailored to the needs of the local jurisdiction.
22. The geologic setting of the City of Burbank is conducive to localized amplification of seismic energy. This can lead to severe structural damage in vulnerable buildings. The most accurate method to evaluate the effect of site amplification in seismic design of structures uses dynamic analysis. Dynamic analysis considers the various frequencies of the structure and the interaction of the structure with probable earthquake sources.
23. Building and Fire Codes are not retroactive. Seismic hazard reduction measures can be used to increase the safety of existing development. Hazard reduction measures range from immobilization of gas-fired heaters to retrofitting or strengthening of buildings or structures. Figure 19 on page 90 presents several of these hazard reduction measures.
24. Real estate disclosure clauses, administered throughout the state and local boards of realtors during property transactions, are used to inform buyers of hazards and available risk avoidance actions.
25. Facilities using, storing, or otherwise involved in the storage of hazardous materials may pose a threat to the community if the facilities experience damage during a strong

EARTHQUAKE VULNERABILITY OF SELECTED CRITICAL FACILITIES IN THE CITY OF BURBANK

HAZARDS		SELECTED CRITICAL FACILITIES AND INFRASTRUCTURE																		
		EMERGENCY FACILITIES			DAM FACILITIES	TRANSPORTATION				UTILITY LIFELINES						URBAN SETTING				
		HOSPITALS	DEPENDENT CARE	FIRE/LAW ENFORCEMENT	RESERVOIRS	FREEWAY INTERCHANGES / BRIDGES	EMERGENCY CORRIDORS	SURFACE STREETS	RAILROAD	ELECTRICAL POWER	ELECTRICAL TRANSMISSION	NATURAL GAS PUMPING STATIONS	NATURAL GAS TRANSMISSION / DISTRIBUTION PIPELINES	GAS UTILITY- BUILDING INTERFACE	WASTE WATER	WATER SUPPLY - FIRE FIGHTING	PETROLEUM PIPELINE	REFINERIES / STORAGE FACILITIES	FACILITIES USING OR STORING HAZARDOUS MATERIALS	INDUSTRIAL ZONES
GROUND SHAKING	125	*	*	1	125	125	256	26	2	25			245	245	2345	245	34	*	*	2346
FAULT RUPTURE	125	*	*	1	125		25						245	2345	2345	34	5	*	*	2346
LIQUEFACTION	125	*	*	1	125	25	25	26		25	245	245	245	12345	245	34	5	*	*	2346



MOST VULNERABLE



MODERATELY VULNERABLE



LEAST VULNERABLE



Although all of the facilities presented in this figure need to be assessed on a site-specific basis, this is especially true of those marked with an asterisk. Some dependent care facilities, for example, may be located in liquefaction-prone areas, however, evaluating each individual facility was beyond the scope of this report.

POTENTIAL IMPACTS

- 1 = Structural / Foundation Failure
- 2 = Functional Loss (If primary)
- 3 = Contamination
- 4 = Fire
- 5 = Emergency Response
- 6 = Economic Impact

The vulnerabilities presented above are generalized. Refer to Chapter IV for a more detailed explanation of the seismic hazards associated with these facilities.

Figure 1. Earthquake Vulnerability of Selected Critical Facilities in Burbank

SCOPE OF SAFETY ELEMENT		SEVERITY OF PROBLEM				CODE CONFORMANCE AND HAZARD MANAGEMENT					
HAZARDS		None	Low	Moderate	Severe	BUILDING	ZONING	SUBDIVISION	FIRE	SPECIAL DEVELOPMENT REQUIREMENTS	HAZARD REDUCTION PROGRAM
EARTHQUAKE DAMAGE	Strong Ground Motion				■	■			■		■
	Fault Rupture			■		■	■	■		■	■
	Liquefaction			■		■	■	■	■	■	■
	Differential Settlement/Compaction			■		■					■
	Landslides/Rockfalls			■		■					■
	Tsunami/Seiches	■									■
	Dam or Levee Failure		■								■
	Subsidence		■			■					■
	Vulnerable Buildings			■							■
	Fire - Building Density			■		■	■	■	■		■
RELEASE OF HAZARDOUS MATERIALS	Atmospheric Release			■		■	■		■	■	■
	Contamination			■		■	■		■	■	■
	Explosion			■		■	■		■	■	■

Special Development Requirements may include additional investigation, site preparation, special foundations etc. Hazard Reduction Features can include proactive or retroactive strengthening, special evacuation or emergency preparedness and planning measures (such as emergency water supply, fire suppression, or drills).

Although the probability of a dam failing is low, public and private emergency preparedness planning should be emphasized for dam inundation studies.

Figure 2. Seismic Hazard Analysis and Management Checklist

earthquake. Foundation and structural distress in structures located in industrial areas subject to liquefaction pose a unique problem not covered by current state legislation and regulations in the Uniform Building Code pertaining to hazardous materials management.

26. Programs aimed at post-earthquake reconstruction are needed to address the difficult decisions that must be made in the aftermath of a damaging earthquake. Ordinances can be implemented to discourage inappropriate development from being reestablished in areas likely to be damaged on a recurrent basis. Such programs might apply to facilities using hazardous materials which are located on or next to an active fault.

C. FIRE HAZARD

1. The Burbank Fire Department currently has a top performance rating, ranked by the Insurance Services Office as a Class 2, which can be equated to "very good". This good rating is reflected in reduced insurance rates for property owners.
2. The Verdugo Mountain area, generally that area above Sunset Canyon Drive, has the potential for wildland fires and is designated as a Mountain Fire zone. This area is for the most part undeveloped, with steep chaparral covered slopes. The Burbank Fire Department has the responsibility for fire prevention programs and fire fighting in this area. Efforts to protect lives and property from wildland fires focus primarily on brush clearance around homes.
3. The City's Fire Prevention Ordinances include detailed measures designed to reduce the losses in life and property damage such as automatic sprinklers and building designs which retard fire. Sprinklers are required in all new construction and in remodeled structures where the new construction valuation exceeds a certain percentage of the current replacement value of the structure. Wood roofs were banned in the City in 1992, and all existing wood roofs must be replaced by the year 2012. There are special building standards for the fire sensitive Mountain Fire zone.

4. The Burbank Fire Department is the authority having jurisdiction over all fires and life threatening incidents in the City; it has ultimate responsibility and liability for the suppression of all fires in the city of Burbank. Even where private companies have their own trained fire fighting personnel and equipment who respond first to a fire emergency, the Burbank Fire Department takes over control when they arrive on the scene.
5. The Burbank-Glendale-Pasadena Airport and the Warner Bros. Studios have their own private on-site fire departments. These on-site emergency teams provide emergency first response in the event of a fire, and assist the Burbank Fire Department by providing back-up first aid. With respect to the Airport Fire Department, this department meets the requirements established by the Federal Aviation Administration Regulation (FAR) Part 139 and under this federal regulation has primary responsibility for rescue and firefighting operations as they relate to aircraft incidents or emergencies on airport property. The airport, including its Operations and Fire departments, undergo annual inspections by the FAA to ensure compliance with the required training and response criteria.
6. The Burbank Fire Department participates in programs which pool fire fighting resources at the state, regional and local (Los Angeles, Glendale and Pasadena) levels.

D. STORM, FLOOD AND MUDSLIDE HAZARD

1. The U. S. Army Corps of Engineers, in conjunction with the Los Angeles County Department of Public Works (LACDPW), has identified several areas within the Los Angeles River incapable of conveying runoff from a 100-year storm. Flooding in Burbank would be limited to just outside the channel confines along the City of Burbank's southernmost boundary line which parallels the Los Angeles River.
2. Flooding is not a significant danger in the City of Burbank. In the flat-land areas of the City, flooding occurs in streets, intersections and under underpasses when the amount of run-off exceeds the capacity of the storm drains and when water accumulates in low lying areas.

3. The hillside areas of the City have the potential for mudslides. With heavy rains, there can occur mudslides resulting from the torrents of rain washing out of the hills into the hillside residential areas. The major factors which contribute to hillside flooding and mudslides are brushfire burnout, inadequate ground cover and hillside grading and construction.
4. Heavy rains and flooding can overload the City's wastewater treatment facility resulting in either diverting the excess sewage to the Los Angeles system or allowing the untreated sewage to flow into the Burbank Western Flood Control Channel.
5. The Field Services Division of the Public Works Department plays the key role in directing all flood control activities. In the event that the City's Emergency Operations Center is activated because of flooding in the City, the Public Works Department is the department designated as the disaster manager.
6. The Public Works Department distributes sandbags, with instructions as to their use, to City residents to mitigate the effects of flooding.

E. AIRPORT ACCIDENT HAZARD

1. The Burbank-Glendale-Pasadena Airport is the source of most air traffic in the City of Burbank. As of 1996, there have not been any aircraft emergencies involving multiple casualties or significant loss of property in Burbank or involving the Airport.
2. In 1996, 4.8 million passengers utilized the airport facility; it is forecasted that passengers served by the airport could more than double over the next 15 years. The potential for airport disaster increases with the increasing number of flights entering and leaving the airport.
3. The Burbank-Glendale-Pasadena Airport has an FAA approved Airport Emergency Plan. This plan sets forth emergency procedures that insure prompt response to all emergencies and other unusual conditions in order to minimize the possibility and extent of personal injury and property damage

on or around the airport.

4. The Burbank Fire Department has ultimate liability and responsibility for all disaster response in Burbank, but it is the on-site Airport Fire Department which responds first to aircraft-related emergencies at the airport.

F. HAZARDOUS MATERIALS INCIDENT

1. There is a definite risk of an accident involving toxic or hazardous materials occurring in the City of Burbank. There are several possible sources for such a hazardous materials incident in Burbank, including the transportation of hazardous or toxic chemicals through the City, the airport, industries and fixed facilities that use or produce hazardous chemicals, underground pipelines and clandestine dumping.
2. The Burbank Fire Department is responsible for responding to all hazardous materials incidents in the City. The Fire Department has personnel trained as hazardous materials technicians as well as a special HazMat Unit which is equipped to be used to assist or manage hazardous material incidents.
3. Burbank Fire Department oversees numerous federal and state mandates, as well as local codes, that relate to the control of hazardous materials. One program is a Hazardous Materials Inventory Disclosure Program which is intended to identify the quantity and type of hazardous materials in the community and the locations where they are stored; another program is the Risk Management and Prevention Program which is intended to manage risk by preventing spills and releases of extremely dangerous materials or at least minimizing the adverse impact such a release may create.

G. CIVIL DISTURBANCE AND TERRORISM

1. Burbank faces risks of civil disturbance and terrorism both from within the community and from adjacent communities.

The tight web of urban development surrounding Burbank and connecting it to adjacent communities places Burbank at risk from civil disturbances which may occur in neighboring cities and spill over into Burbank, such as the Los Angeles riots in 1992.

2. Burbank Police and Fire departments have specific policies and procedures that dictate response during a civil disturbance. At the first warning of a potential civil disturbance, an emergency response is initiated.

III. EMERGENCY RESPONSE

The City of Burbank's response to emergency situations is directed in great detail by the City's Multi-Hazard Emergency Operations Plan (EOP). This plan designates appropriate responses on the part of City departments and enlists several private organizations in times of a disaster.

The Police and Fire departments have been delegated major responsibilities in carrying out the Emergency Plan. A variety of City departments are included in implementing emergency procedures such as keeping streets clear, coordinating with utility companies, and providing an array of emergency services to residents. These services include alerting and warning, communications, situation analysis, management, public information, fire and rescue, traffic control, law enforcement, disaster medical care, public health, coroner, care and shelter, movement, engineering and construction, supply/production, personnel, utilities and transportation functions.

A. THE MULTI-HAZARD EMERGENCY OPERATIONS PLAN

Burbank's Multi-Hazard Emergency Operations Plan provides guidance for City responses to extraordinary emergency situations associated with natural disasters, technological incidents, and nuclear defense operations--both war and peacetime. This plan does not address ordinary day-to-day emergencies or the established departmental procedures used to cope with such incidents. Rather, this plan concentrates on operational concepts and response procedures relative to large scale disasters.

The EOP has three major parts.

1. Part One--The Basic Plan contains an overview of the potential hazards which could face the City of Burbank and the authorities and references providing the legal basis for planning. It also describes the county's and City's responsibility to prepare for, respond to and recover from an emergency. This section of the EOP deals in great detail with each of the following hazards which might effect the City of Burbank: major earthquake; hazardous materials incident;

urban wildfire; civil disturbance; aircraft accident; national security incident or war; as well as floods, storms and mudslides.

2. Part Two -- Functional Sections define the functions to be performed in an emergency, list the agencies and City departments responsible for the functions, and describe how they will perform the assigned tasks.
3. Part Three -- Operational Data includes notification lists, resource lists and other miscellaneous information pertinent to the administration of the plan.

B. THE EMERGENCY OPERATIONS CENTER

City functions are normally conducted from departments and offices that are widely dispersed throughout the City of Burbank. When a major emergency or disaster strikes, centralized emergency management is needed, and this takes place in the Emergency Operations Center (EOC). This facilitates a coordinated response by staff and representatives from various departments who are assigned emergency management responsibilities in the City.

An EOC provides a central location of authority and information and allows for face-to-face coordination among personnel who must make policy level emergency decisions. The following functions are performed in the City of Burbank EOC or alternate EOC, as necessary.

- Receiving and disseminating warning.
- Managing emergency operations including resource coordination and allocation.
- Developing emergency response and recovery policies.
- Collecting intelligence from and disseminating information to the various EOC representatives, and assuring coordination between the field incident locations, building managers and zone wardens throughout the City system. In addition, as appropriate, coordinate information with Los Angeles County, the Governor's Office of Emergency Services, the Federal Emergency Management Agency and other appropriate outside agencies.
- Preparing intelligence/information summaries, situation reports, operation progress reports and other reports as required.

- Maintaining general and specific maps, information display boards and other data pertaining to emergency operations and the status of City buildings and sites.
- Continuing analysis and evaluation of all data pertaining to emergency operations.

Generally, the EOC will be activated under the following conditions:

- An earthquake causing widespread damage;
- A hazardous materials incident affecting a portion of the City;
- A major storm affecting the City and surrounding areas;
- An emergency situation that has occurred or might occur that is of such a magnitude it will require a large commitment of City of Burbank or Los Angeles County resources over an extended period of time to control or mitigate.

The EOC can be activated and staffed to the extent deemed necessary to deal with the existing or impending emergency. The level of activation is determined by the City Manager (Director of Emergency Services) or his/her designated alternate. This activation takes place upon consideration of initial damage assessment reports and demand for services. Three levels of activation are described below.

1. Level 1 Disaster -- Normal Operations

Normal day-to-day emergency operations for which Burbank resources, as well as mutual aid resources, are adequate to handle the incident. The EOC may be activated to support a department's operations.

2. Level II Disaster -- Partial EOC Activation

An incident which involves more than two major City departments and which the incident commander feels has the potential to escalate into a Level III Incident. The Director of Emergency Services selects members of the EOC team to be called. The EOC is activated on a limited basis. Example: Large hazardous materials incident or partial/predicted flooding/storms.

3. Level III Disaster -- Full EOC Activation

A disaster which requires activation of the Emergency Management Team in the City's EOC. A disaster requiring policy and coordination to mitigate further loss of life and property. The EOC would be fully activated and all of the EOC positions filled. Example: A major earthquake causing substantial damage in the community.

The following individuals are authorized to activate the city of Burbank EOC.

- Director of Emergency Services (City Manager)
- Fire Chief and Line Battalion Chief
- Police Chief, Police Watch Commander and Field Sergeants
- Public Services Department Director
- Public Works Director

The primary and alternate locations for the EOC are as follows.

- Fire Training Center (PRIMARY)
1845 North Ontario Street
- Police Headquarters
272 East Olive Avenue
Basement

Figure 3 on page 19 shows the locations of emergency resource sites including medical facilities, helicopter landing sites, shelters and fire stations.

C. POLICE

The primary role of the Burbank Police Department is to ensure public safety by protecting the public from crime. Although the Burbank Fire Department has direct responsibility for coordinating most disaster response in the City, the police assist in many phases of disaster response, especially traffic control and controlling civil disturbances, such as riots and looting which sometimes follow a major disaster (see discussion of Burbank Fire Department in Section V.C.).

LEGEND

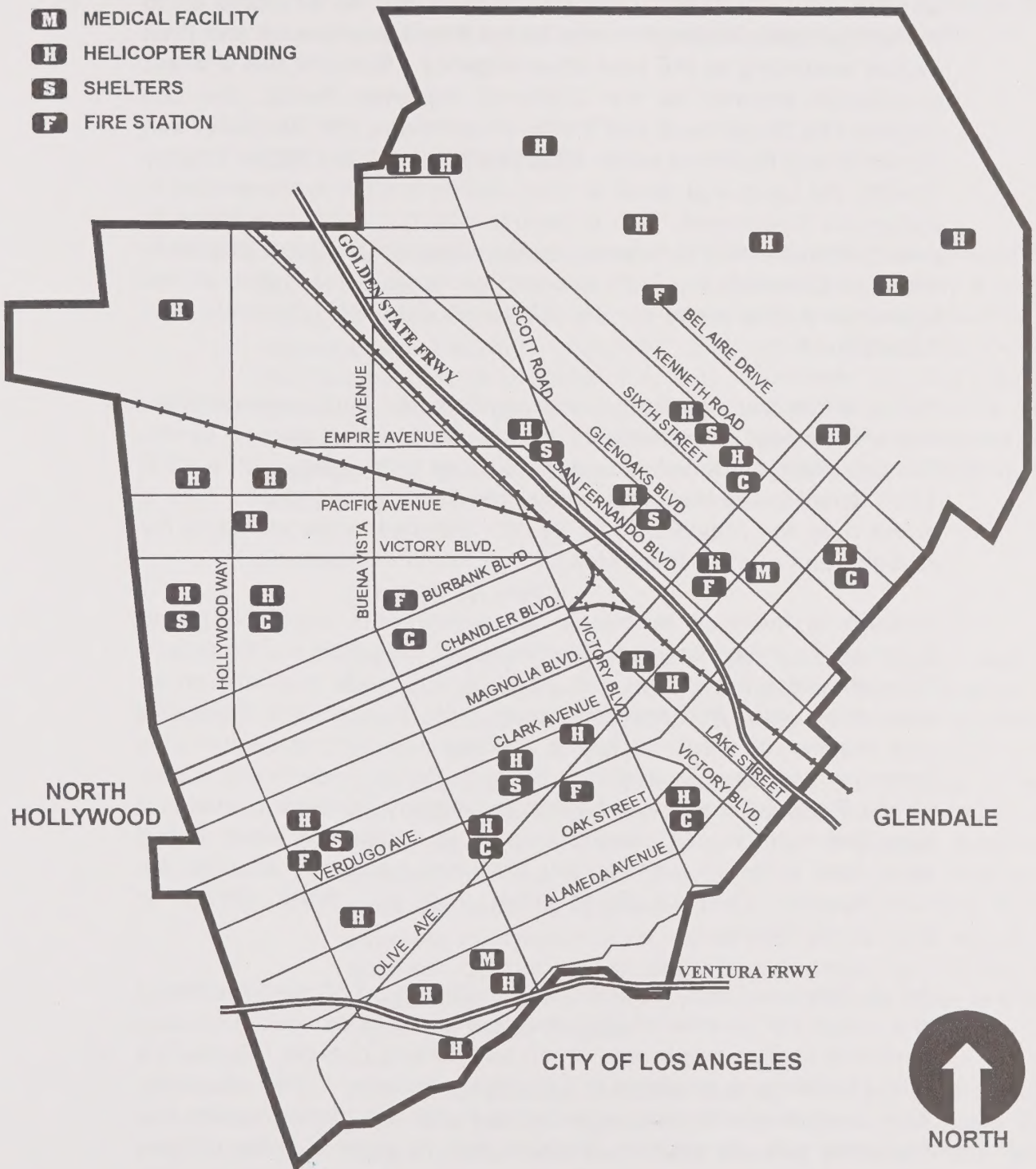
C CASUALTY COLLECTION POINTS

M MEDICAL FACILITY

H HELICOPTER LANDING

S SHELTERS

F FIRE STATION



CITY OF BURBANK EMERGENCY RESOURCE SITES

Figure 3. Emergency Resource Sites

Burbank has an enhanced 911 Emergency Call System which incorporates a video screen which shows the caller's phone number and address, as well as the telephone billing name. All 911 calls go to the central police dispatch center where they are screened and then routed according to the type of emergency. Burbank has a direct one-button transfer to the California Highway Patrol, the Los Angeles Fire Department and Police Department, the Glendale, San Fernando and Pasadena police departments, the Los Angeles County Sheriff, the Language Bank (a state facility providing translators in numerous languages), TDD (a service which enables the Police to communicate with the hearing impaired) and to Verdugo Dispatch. Verdugo Dispatch is a joint dispatch center which handles all fire department responses in the Cities of Burbank, Glendale and Pasadena.

Burbank has an excellent response time for local emergencies, averaging about three minutes per call for the past several years. The City has maintained a consistently low crime rate, with a 47.0 1994 Crime Index (reported crimes per 1,000 population). This is lower than the previous three years. Detailed crime statistics for Burbank and comparable cities can be found in Appendix I.

Burbank is involved in mutual aid agreements with the police departments of Los Angeles, San Fernando, Glendale and Pasadena through which manpower and equipment is made available on an emergency basis. Burbank cooperates with Glendale and Pasadena in a number of areas, including training and joint operation of a helicopter program. In addition, Burbank Police Department is part of the State Emergency Aid System whereby Burbank provides a specified number of trained officers and equipment when called upon and, in return, can request aid when necessary through the Los Angeles Sheriff's Department and the State Office of Emergency Services.

As of January 1995, Burbank was authorized 156 sworn officers and about 80 full-time civilian police employees as well as several part-time civilian employees (such as crossing guards). Burbank's ratio of officers to residents is 1.6 officers to every 1,000 residents. This is an excellent ratio considering Burbank's demographics and low crime rate. In addition, Burbank has 15 reserve police officers who are trained and assist police by patrolling two shifts per month, staffing special events and working during times of disaster.

The Burbank Police Department has an Unusual Occurrences Manual which is an immediate resource for handling unanticipated occurrences, such as downed aircraft, hazardous materials incident,

hijacking or attempted hijack of an aircraft, a hostage situation or barricaded suspect, a major civil disturbance, and an earthquake, flood or other natural disaster. The Police Chief may activate the Emergency Operations Center should he deem it necessary.

D. CRITICAL FACILITIES

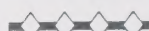
Critical facilities are those systems or facilities which are critical for sustaining life in the City and are vulnerable to disruption by a major disaster. These facilities are the water supply system, electricity, natural gas and sewage treatment. Each of these systems, except for natural gas, is provided for, and maintained by, the City of Burbank. Natural gas is supplied by the Southern California Gas Company. In each case, detailed plans are in place to ensure the resumption of these necessary systems as quickly as possible in the event that they are cut off due to a major disaster.

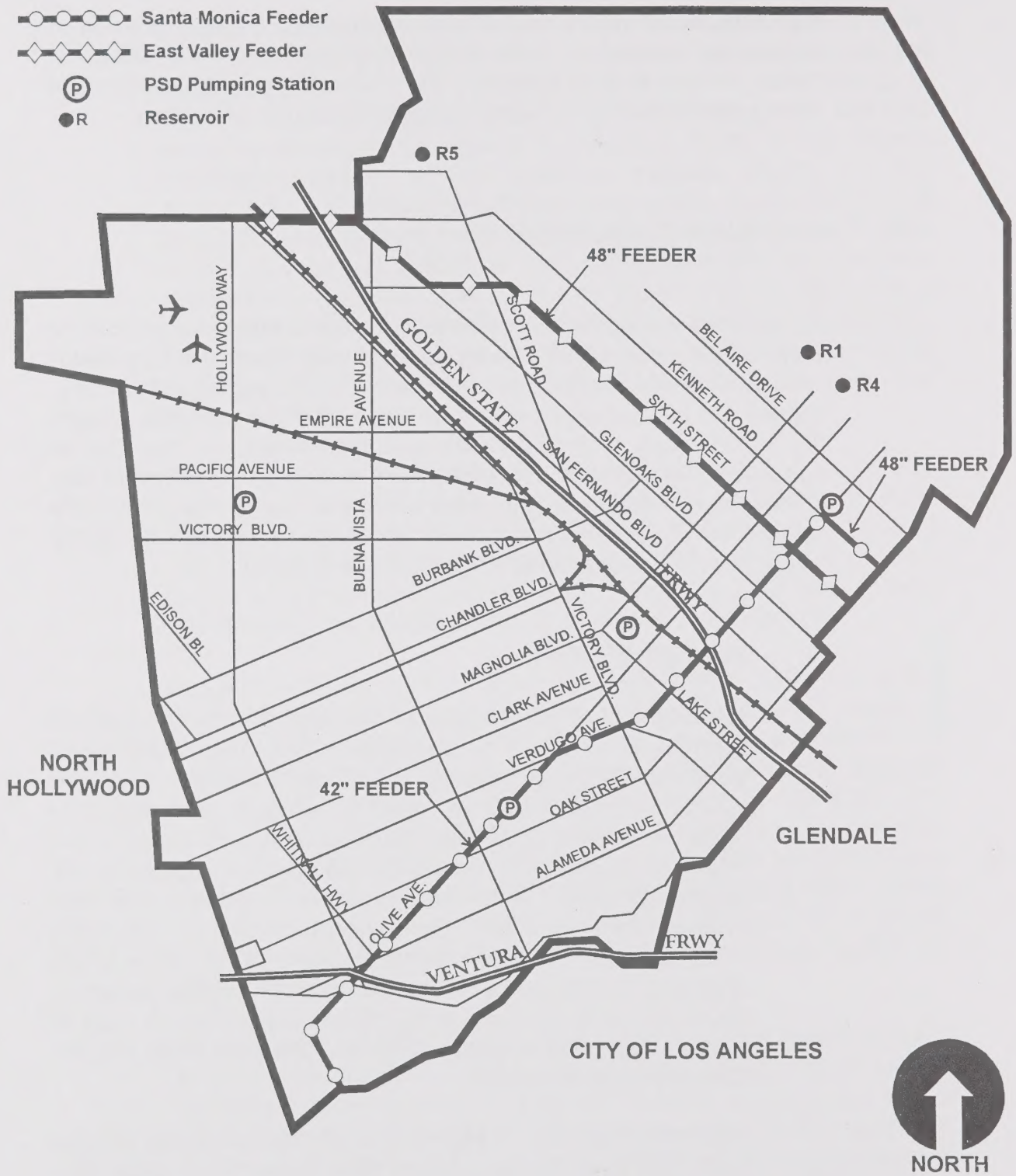
1. WATER SUPPLY

Approximately 50 percent of the potable water used in Burbank is provided by the Metropolitan Water District of Southern California (MWD). The City must order its water supply from the MWD 24 hours in advance, and may only place one order a day. If the actual daily use of water is less than was ordered from the MWD, the surplus is stored in the City's reservoirs. If the use of water is greater than was ordered from the MWD, the water in the City's reservoirs must be used to supplement the difference. The MWD attempts to maintain a six-month reserve of water supply in Southern California, west of the San Andreas Fault in case of a major disruption of supply from the Colorado River and the California Water Project.

The MWD services Burbank through two separate feeders with five service connections (see Figure 4 on page 22). Burbank also has two wells serving potable water after treatment to remove volatile organic chemicals. These wells require electric power to be pumped. They have the capacity to service about 10 percent of the City's water needs.

LEGEND

-  Santa Monica Feeder
-  East Valley Feeder
-  PSD Pumping Station
-  Reservoir



CITY OF BURBANK WATER SYSTEM

Figure 4. City of Burbank Water System

The City of Burbank is participating in a groundwater clean up at the Valley Plant in conjunction with Lockheed-Martin under the auspices of the Environmental Protection Agency. The treated water supplies up to 60 percent of the City's need. The groundwater treatment plant requires that the production, treatment and distribution equipment have electrical power and that the MWD is able to provide water for the blending facilities.

In the event of an emergency in which the water supply to the City is cut off, Burbank has approximately two days of maximum water storage capabilities.

Should there be a Citywide emergency, the primary use of the water reserve will be directed toward fighting fires. The number and intensity of fires will have a direct effect on how large the water supply will be for other essential uses. Next, the water supply would be used for sanitation and drinking to sustain life until full service is resumed.

The water system in Burbank is considered to be reliable in the event of a Citywide emergency, such as an earthquake. Both of the City's wells can be used in such an instance if they remain structurally intact, and if there is power to work them. The water transmission system is very sound as evidenced by the minimal main line breaks or leaks during normal conditions.

Burbank's three largest reservoirs (Nos. 1, 4 and 5) are considered to be dams due to their high volume capacity. Since they are considered dams, they are under continuing inspection by the State of California Bureau of Dams. Reservoirs Nos. 4 and 5 are built with reinforced concrete and Reservoir No. 1 has a structured earth fill and has been determined to be "grossly stable" in the event of an earthquake. The Burbank water system experienced no difficulties during the 1987 Whittier earthquake nor as a result of the 1994 Northridge Earthquake, and only minor service and water main difficulties were experienced in the 1971 Sylmar Earthquake.

PSD participates in all City disaster preparedness activities in which many different possible scenarios have been analyzed. Disaster responses by PSD have been anticipated and planned. Further discussion of Burbank's water systems can be found in Section IV, Seismic Hazards, on page 30.

2. ELECTRICITY

Burbank's electric power system is comprised of generating plants, natural gas lines bringing fuel to the plants and fuel storage tanks supplying these plants, transmission switching stations and distributing stations, overhead and underground transmission lines, and small emergency power generators (see following Figure 5).

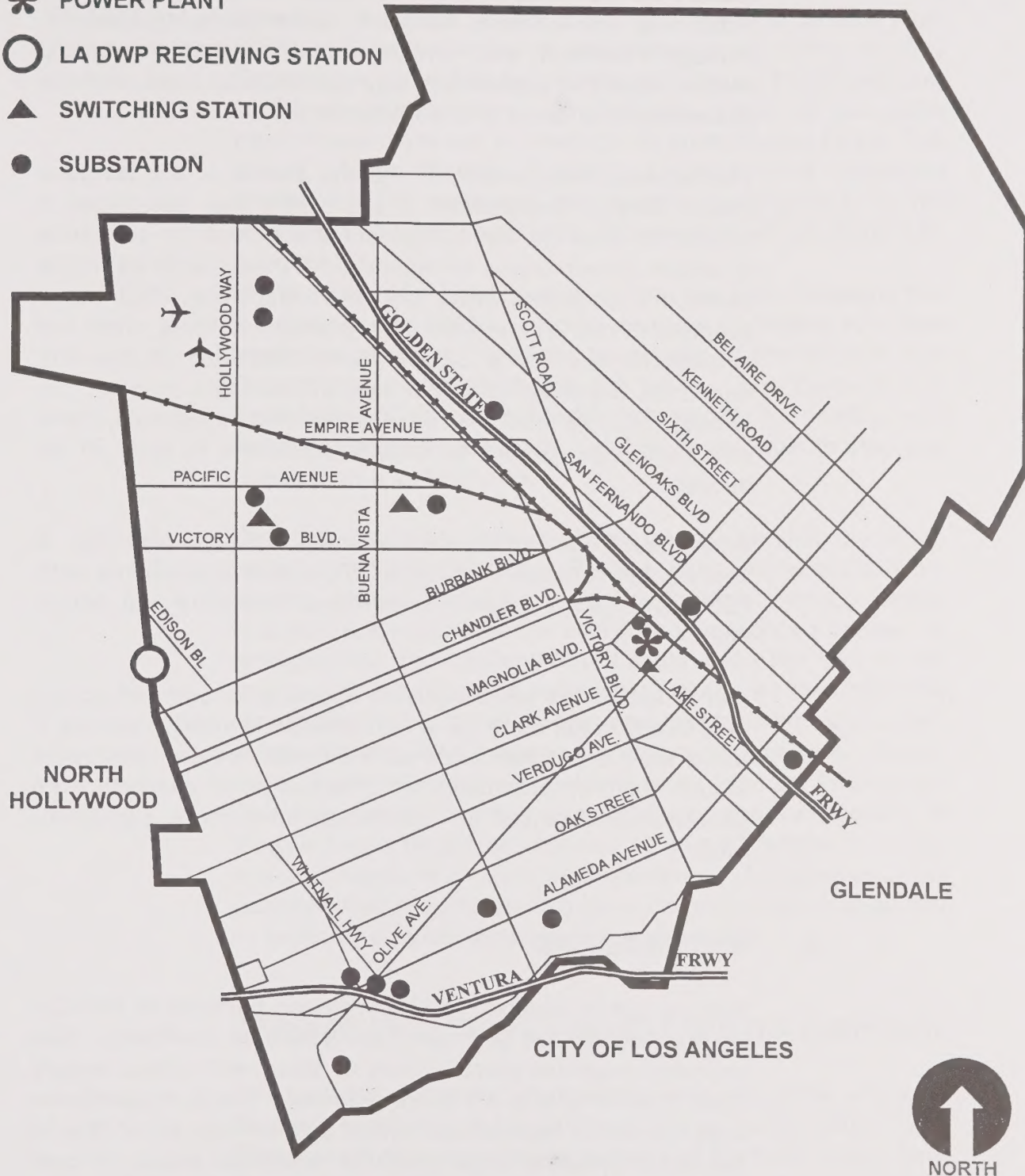
The City of Burbank owns two primarily natural gas fired generating plants; the Magnolia and Olive generating plants together have a total combined generating capacity of 233,000 kilowatts. While this is enough to provide for all of Burbank's needs on most days of the year (except during the hottest summer days), 80 percent of Burbank's power is usually purchased from various sources outside the Los Angeles Basin because it is more economic to do so. Burbank's generating units, however, are essential to meet continuous changes in load, providing firm power, back-up power in the event remote sources are lost, and in maintaining voltage regulation. All purchased power is delivered over the Los Angeles Department of Water and Power (LADWP) system through a 480 MVA, 230-69 kV interconnection at Los Angeles' Receiving Station "E" (RS-E), located on Whitnall Highway near Burbank Boulevard (see Figure 5 on page 25).

Both overhead and underground electrical transmission, subtransmission and distribution facilities are susceptible to damage from earthquakes; intense, low-frequency ground motion can damage or temporarily disable these facilities. However, unless ground failure occurs, generating plants, due to their design, generally experience very minimal damage when exposed to earthquakes up to 6.5 Magnitude, but may automatically trip off-line to minimize the damage. Depending upon its duration and magnitude, an earthquake could cause a systemwide outage.

Damage to Burbank's power plants would very likely reduce generating capacity. This reduction could be partially offset, however, by the temporary loss of customer load due to earthquake damage and the availability of outside sources of electricity, assuming that RS-E and the necessary transmission facilities are in service. Priority would be given to

LEGEND

- * POWER PLANT
- LA DWP RECEIVING STATION
- ▲ SWITCHING STATION
- SUBSTATION



CITY OF BURBANK ELECTRIC SYSTEM-MAJOR FACILITIES

Figure 5. City of Burbank Electric System--Major Facilities

restore service critical to public health and safety, such as police and fire facilities, hospitals, water pumping stations, sewage treatment, etc. Major restoration problems would involve repairs to substations, key transmission lines, and the replacement of poles and transformers.

The agency responsible for electric power is the Burbank Public Service Department (PSD). PSD has developed a priority list of all critical facilities in the City and the sequence in which power would be restored to those facilities in the event of a disaster. After the critical facilities, PSD would supply the rest of the City with power. If there were not enough for the entire City, different sections of the City would be provided alternate use of available power. All critical facilities using electricity, such as hospitals, have emergency generators to supply electricity in case of an outage.

When such an emergency occurs, PSD's response is coordinated through the City's EOC and in accordance with PSD's Emergency Service Restoration Procedure and Action Plan.

The threat of fire resulting from sparking or downed power lines in a disaster such as an earthquake is small, because if there were a problem with the electrical system, electricity would be cut off automatically. The danger of sparking from power lines downed in high winds is a more significant hazard.

3. NATURAL GAS

Natural gas is supplied to all developed portions of the City of Burbank by the Southern California Gas Company. Gas supplies originate primarily out of state with minor supply from California and off-shore sources. Major transmission lines operate at high pressure while smaller lines are in the 40 pounds of pressure range typical of residential areas. In case of emergencies, the larger diameter transmission lines are controlled by automatic valves while the smaller lower pressure lines are controlled by manual operation.

All gas lines are buried with the exception of regulator stations located strategically through the system. Depth of the piping system varies depending on pipe diameter and

subsurface infrastructure, with a minimum depth of 32 inches standard. A private service called Underground Service Alert (USA), will, when notified of excavation work, notify the Gas Company which will in turn locate and mark natural gas lines in the excavation area. In Burbank, some of the major transmission lines are in Verdugo Avenue, Reese Place, Oak Street, Lake Street, Victory, Burbank and Glenoaks Boulevards (for additional information, see Figure 6, on the following page and Section IV, Seismic Hazard, on page 30).

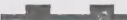
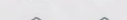
In the cases of a gas line leak or fire, the Gas Company has ultimate responsibility. However, the company will only handle an emergency with the permission of the Burbank Fire Department who will assign the tasks. The Burbank Fire Department (BFD) is the agency responsible for dealing with the suppression of gas fires. The BFD is also able to stop gas leaks up to a certain size.

The Gas Company has 24-hour on-call service crews to respond to emergencies. Repairs vary dramatically from closing sections of pipe to a simple pipe clamp. Repair evaluations are made on the scene by experienced crews. In emergencies, the Fire Department is generally the first on the scene and establishes a safety perimeter. At this point the responsibility for handling the emergency becomes a joint effort with the Gas Company to resolve the incident. During major emergencies the Gas Company opens an Emergency Operating Center to direct company resources as needed. If there is a loss of gas service due to an emergency, at worst it would result in a major inconvenience. Facilities such as hospitals that require heating have an alternative fuel supply in tanks to provide temporary space heating.

4. SEWAGE TREATMENT--WASTE WATER DISPOSAL

Most of the domestic, commercial and industrial waste in Burbank is treated at the Burbank Water Reclamation Plant. The amount of waste treated outside of Burbank varies from day to day and is treated at the Los Angeles-Glendale Water Reclamation Plant and later sent to the Los Angeles Hyperion Treatment Plant. Topographic conditions within the City largely dictate to which treatment plant the sewage will be directed.

LEGEND

-  HIGH PRESSURE GAS LINE
-  14" FOUR CORNERS PIPELINE
-  20" PROPOSED PACIFIC PIPELINE-CRUDE OIL



CITY OF BURBANK NATURAL GAS and PETROLEUM TRANSMISSION LINES

The vulnerabilities presented above are generalized. Refer to Chapter IV for a more detailed explanation of the seismic hazards associated with these facilities.

Figure 6. Natural Gas and Petroleum Transmission Lines

Treated waste water generated by the City of Burbank sewage treatment facility is discharged into the Los Angeles River with some reclaimed water being used for coolant at the City's electrical generating station and for watering municipal open space facilities. In addition, some reclaimed water is sold to Caltrans for freeway landscape watering in the Burbank area. A detailed discussion of Burbank's waste water treatment facility can be found beginning on page 81 in the Seismic Hazard Section.

While the sewage system is not invulnerable to large scale catastrophes, such as earthquakes or fires, the risk of a safety or health threat caused by such an incident is very minimal. Further discussion of the effects of an earthquake on the sewage system in Burbank can be found in Section IV, Seismic Hazards, page 81.

Sewer lines in Burbank are buried underground, so an above ground hazard is very unlikely. Cases of above ground hazards caused by a sewer system leak can be easily localized and quickly oxidized with chlorine so that it will no longer pose a health threat. In the rare case of an underground leak, the ground could become contaminated. This however would not cause a public health risk, as it would simply be absorbed by the ground soil.

If a catastrophe caused the Burbank Water Reclamation Plant to become inoperable, all of the sewage would be passed directly to the Los Angeles Hyperion Treatment Plant. If this too is inoperable or unable to accept Burbank's sewage, the sewage would flow directly into the flood control channel.

IV. SEISMIC SAFETY HAZARD

A. INTRODUCTION

The 1989 Loma Prieta Earthquake and the 1994 Northridge Earthquake were poignant reminders of the value of seismic safety-oriented planning and programs. While earthquake risk cannot be entirely eliminated, the disasters that they cause can be significantly reduced through the informed application of regulatory measures and land use approaches, effective disaster response planning, and public hazard awareness.

Since required as a state statute in 1971, in response to the San Fernando Earthquake, the City of Burbank has adopted successive and improved versions of the Safety Element. The first interim Safety Element was adopted by the City Council in 1972 and subsequently modified with improved geologic and seismic studies in 1974. In 1983, Burbank adopted a separate Seismic Safety Element in keeping with state law at that time; a separate element dealing with seismic safety issues is no longer required. Sections 65302(g), 65303, and 8876 of the California Government Code now require each local government to maintain a comprehensive Safety Element that addresses a variety of hazards, both natural and urban, including seismic safety. Safety Elements, as dictated by the State of California, should include a discussion of the following seismic safety issues, where applicable:

- Seismic hazards including risks associated with ground shaking, surface fault rupture, and ground failure;
- Geologic hazards such as landslides and collapsible soils; and
- Flood and inundation hazards including structural failure of water storage facilities, and where appropriate, damages resulting from tsunami, seiche and flooding.

This section of the Safety Element focuses on an analysis and understanding of seismic hazards. It incorporates lessons learned from previous earthquakes as well as detailed seismic hazard studies conducted by the United States Geological Survey (USGS) and by the California Division of Mines and Geology. Appendices II through IV provide some of the detailed technical data upon which the seismic analysis for Burbank was based.

The City of Burbank is located in seismically-active southern California (see Figure 7 on page 33). Several faults in the southern California metropolitan area have moved in historic time; undoubtedly these faults will move again. The better known active and potentially active faults are shown in Figure 7, however, other less-known faults may also be capable of generating large earthquakes within a time span of concern to the City. To minimize or accommodate the destructive effect of earthquakes, planners and engineers need to know which faults are more likely to slip again, and what the likely results of such movement will be. The 1987 Whittier Narrows Earthquake, the 1989 Loma Prieta Earthquake in northern California and the recent 1994 Northridge Earthquake have reinforced the notion that if potential problems are identified through hazard mapping, and mitigated through prudent planning, Building Code enforcement, and expedient retrofitting and rehabilitation, the scope of an earthquake disaster can be reduced significantly.

The January 17, 1994, Northridge Earthquake occurred on a previously undetected fault and resulted in extensive damage and loss of life throughout the metropolitan area; gas and oil lines ruptured, major freeways were closed as a result of collapse or damage, water mains ruptured leaving thousands of people without water, and fires destroyed numerous structures. The City of Burbank sustained minimal damage compared with adjacent communities. The City sustained more damage from the 1971 San Fernando Earthquake. Only 13 structures (four commercial, six single family homes and three multi-family apartment buildings with 36 units) were uninhabitable and 31 structures had limited access, including one school and one airport structure. The City activated its Emergency Operations Center (EOC) less than one hour after the earthquake and by the next day went into recovery mode. This earthquake allowed the City and community the opportunity to test their earthquake preparedness skills and to find strengths and address the weaknesses of preparedness and response.

In January 1996, the State Department of Conservation's Division of Mines and Geology (DMG) released 16 Reconnaissance Seismic Hazard Maps covering the region most affected by the 1994 Northridge Earthquake, including the Burbank area. The hazards addressed by these maps are liquefaction and earthquake-triggered landslides. These preliminary maps are the first step in implementing the Seismic Hazards Mapping Act (SHMA) passed in response to the 1989 Loma Prieta Earthquake in the San Francisco Bay area. The purpose of this legislation is to reduce the threat to public health and safety and to assist local governments in minimizing future losses due to liquefaction, earthquake-induced

landslides and other seismic hazards.

The SHMA requires the State Geologist to issue Seismic Hazard Zone Maps. The Act also requires cities and counties, once the maps are issued, to use the maps in land use planning and the permitting process by requiring site-specific geotechnical studies prior to permitting certain types of development. The Act also requires sellers of real property in a designated hazard zone to disclose this fact to potential buyers. The State Geologist indicates that the Seismic Hazard Zone Map for the City of Burbank will probably be available sometime in 1998. Until the official maps are ready for Burbank, however, the State Geologist has provided the City with an interim product (the Reconnaissance Seismic Hazard Map) that depicts areas where geotechnical site investigations should be conducted prior to initiating sensitive, high-risk construction and development projects.

The SHMA leaves the implementation procedures to the discretion of local governments; however, the State Mining and Geology Board is drafting guidelines to assist in local implementation. Cities and counties must regulate certain types of development within the designated hazard zones.

The Public Resources Code Section 2699 directs cities and counties to "take into account the information provided in available seismic hazard maps" when it adopts or revises the safety element of the general plan and in land use planning or permitting ordinances. Plate 1, the Seismic Hazards Constraints Map prepared for this Safety Element, is consistent with the information on liquefaction hazard and fault rupture hazard provided by the Department of Conservation, as it appears in the Reconnaissance Seismic Hazards Map prepared for the Burbank area. The State Geologist has reviewed the City's Seismic Hazards Constraints map (Plate 1) and provided recommendations and comments which have been incorporated into this Element to ensure consistency with the finding of the Department of Conservation.

This Seismic Safety Hazard Section of the Safety Element incorporates information prepared by Leighton and Associates, Inc., Geotechnical and Environmental Engineering Consultants. The City of Burbank retained Leighton and Associates to prepare the technical database for the revision of the seismic safety hazard section of the Safety Element, as well as to review the Element's Seismic Hazards Constraint Map for consistency with recent information made available by the State Geologist. Parts of the technical database have been reproduced in the appendices.

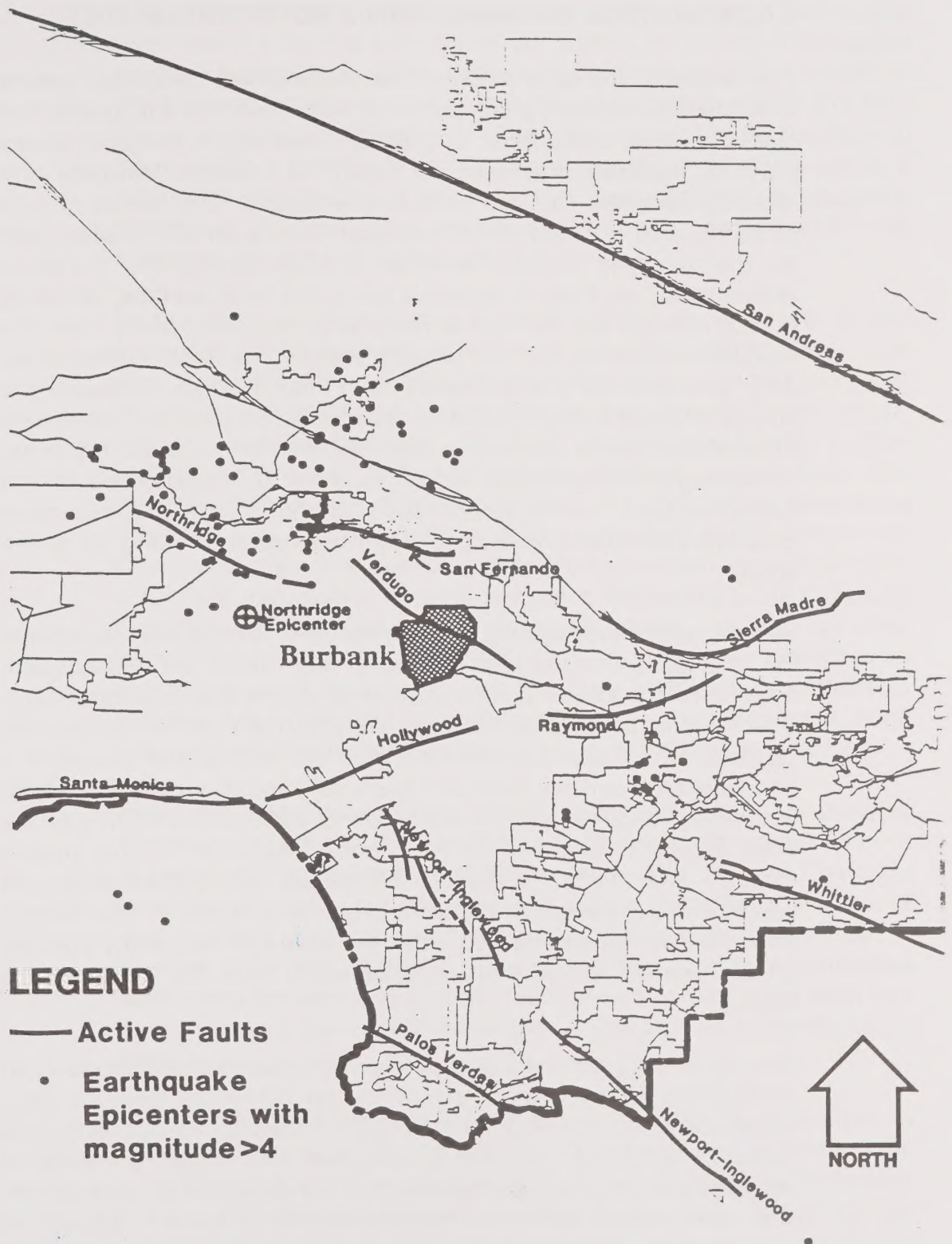


Figure 7: Major Faults and Historical Seismicity in Southern California

B. BACKGROUND INFORMATION AND TERMINOLOGY

The motion of the earth's continental plates (plate tectonics) results in stress accumulation along zones of weakness. Excess stress that has built up in a region as a result of these active tectonic forces may be released gradually, as creep, or released abruptly and violently along the weakest parts of the region. The abrupt release of stress (slip) is called an earthquake. During an earthquake, part of the released energy is used in overcoming the frictional resistance of the earth's materials along the fault surface, resulting in fault rupture, and the rest of the energy is carried away from the rupture area in the form of seismic waves. In small earthquakes, only a section of the causative fault may rupture, because the energy released is insufficient to overcome the frictional resistance of rocks away from the earthquake's source. In major earthquakes, the energy released is sufficient to break a large portion of the causative fault. In the worst-case scenario, that is, the maximum credible earthquake, the causative fault ruptures along its entire length.

Seismic waves propagating through the earth's crust are responsible for the ground vibrations normally felt during an earthquake. Seismic waves vibrate up and down and side to side at different frequencies, depending on the frequency content of the earthquake rupture mechanism, the distance from the earthquake source to a particular site, and the path and material through which the waves are propagating. As seismic waves travel through the earth's crust, their energy is lost due to the inelastic behavior of the ground motion, and due to scattering, diffraction and deflection as the waves cross materials of different physical properties. The overall effect, known as attenuation, alters the form and frequency content of the seismic waves with distance away from the earthquake's source.

Ground shaking generally causes the most widespread damage in an earthquake. Strong ground motion can catastrophically damage vulnerable structures such as freeway overpasses and unreinforced masonry buildings. Ground shaking can also trigger a variety of secondary hazards such as liquefaction, landslides, soil subsidence, fire, dam failure and even toxic chemical releases. Structures straddling a causative fault will be severely damaged if the fault ruptures during an earthquake. The following discussions will more thoroughly address the hazards of strong ground motion, fault rupture and liquefaction.

A fault is an area of weakness in the earth's crust. The largest earthquake a fault is capable of generating is termed a maximum credible earthquake. This involves rupture of the entire length of the fault and has the lowest probability of occurring within the time frame of most development. The most probable earthquake to occur within a specific time frame of interest, for example within a 30 to 100 year period, is termed a maximum probable earthquake. Maximum credible and maximum probable earthquakes are measured in terms of magnitude (M).

Earthquake events occurring close to a point of reference, in this case the City of Burbank, are termed near-field earthquakes. The shaking resulting from a near-field earthquake is rough and jerky and is particularly damaging to single-story and other short buildings, and to electrical facilities. Far-field earthquakes exhibit a slow rolling motion that will last several seconds longer than that resulting from a near-field earthquake. An earthquake generating from the San Andreas fault would be a far-field earthquake in the City of Burbank. The low-frequency ground motion associated with a far-field earthquake is generally more damaging to mid-rise and high-rise buildings and other large structures, as well as their nonstructural internal components and furnishings. Nonductile structures, such as unreinforced masonry buildings, regardless of whether it is a near-field or far-field earthquake, are generally much more susceptible to damage than ductile wood-frame buildings.

Faults are classified as either active, potentially active, or inactive depending on the risk the fault poses to development or the amount of knowledge compiled for a particular fault. The State of California uses the geologic time scale as a yardstick to measure the risk of surface fault rupture as called for in the Alquist-Priolo Special Studies Zone Act of 1972. The probability of a large damaging earthquake occurring on a given fault generally decreases with age of the latest proven fault movement. This can be summarized as follows.

- Active Fault--A fault on which movement has been proven to have occurred within the last 11,000 years. Active faults have a high-risk of surface rupture. The Alquist Priolo Special Studies Zone (APSSZ) Act focuses on this risk category, which can be associated with a maximum credible earthquake. Smaller, maximum probable earthquakes occur more frequently on active faults.
- Potentially Active Fault--A fault which shows evidence of surface displacement during the last two million years, but for which it

has not been proven whether or not it displaces sediments younger than 11,000 years. These faults have the next lowest probability of being the site of a damaging earthquake. Although maximum credible earthquakes on these faults are very unlikely, maximum probable earthquakes may occur during a time span of concern to urban planners, engineers and developers. Potentially active faults are considered in the design of critical facilities such as dams, fire stations, emergency operation centers, etc.

- Inactive Fault--A fault which has been proven by direct geologic evidence not to have moved in the last 11,000 years. This type of fault is thought to pose no risk to conventional development and most critical facilities. Such faults however are considered potential seismic sources in the design of nuclear power plants.

While the description of an earthquake size is usually expressed as a magnitude, an earthquake's destructiveness has commonly been measured as seismic intensity. A common intensity scale consists of 10 to 12 levels of shaking; the higher the number, the greater the damage. Seismic intensity scales have been developed by quantifying relative damage levels observed in past earthquakes. The intensity scale most often used is the Modified Mercalli (MM). Magnitude and intensity measures are discussed in more detail in Section C.2., under "Ground Shaking Hazard". It is a general description that depends not only on the size of the earthquake and the distance away from the earthquake source, but also on the quality of construction that has been damaged and the nature of local ground conditions.

C. SEISMIC HAZARDS ANALYSIS

Studies conducted by the California Division of Mines and Geology, the U.S. Geological Survey, and other agencies and private institutions have been reviewed and are summarized in this section to address the seismic hazards of most concern to the City of Burbank. These seismic hazards include ground shaking, fault rupture and liquefaction. This section discusses, in a general way, how and why earthquake hazards occur, and how seismic hazards are modeled and quantified for prediction and planning purposes. A discussion on the complexities of analyzing earthquake hazards is presented to familiarize the reader with the uses and limitations of the earthquake scenarios presented in Section D and the hazard management alternatives presented in Section F.

There are numerous active and potentially active faults in southern California which, in the event of an earthquake, have the potential for generating strong ground motions in Burbank (see Figure 7 on page 33). A far-field earthquake on one of the more distant faults, such as the San Andreas, would be less damaging in Burbank than a near-field earthquake on a closer fault such as the Verdugo Fault. Some of the more distant faults, however, have a higher probability of occurrence; Appendix IV shows a list of all known, potentially causative faults in the region, and the probable effects on Burbank of a maximum credible earthquake on each fault. The major known faults in the region are listed below; four have been selected for special analysis due to the fact that they are near-field sources, most with relatively high probabilities of generating maximum credible earthquakes in 100 years (Verdugo, San Fernando, Hollywood and Sierra Madre faults). Further discussion of these faults can be found in Section D and in Appendix II.

Major southern California faults with a potential for impacting the City of Burbank are the following.

San Andreas Fault. The San Andreas Fault is considered to be the major geological structural feature of southern California; the San Andreas Fault zone is approximately 27 miles from the City. A catastrophic earthquake having a Richter magnitude of 8.3 on the southern central portion of this fault is likely before the end of the 20th century and is estimated to have a current annual probability of occurrence between two and five percent.

Newport-Inglewood Fault. This fault is considered the second most active fault in California, located about 12.5 miles southwest of the Civic Center. This fault is capable of producing earthquakes in a range of 6.3 to 7.5 magnitude.

Sierra Madre-San Fernando Fault System. This fault system stretches from Cajon Pass in San Bernardino County to Ventura. It includes the Cucamonga, Sierra Madre, San Fernando and Santa Susanna faults.

Sierra Madre Fault. This fault extends along the base of the San Gabriel Mountains between Sunland and La Crescenta Flintridge. This fault is estimated to generate a maximum credible earthquake of magnitude 6.4, generating maximum seismic intensities of 8.5 to 9.0 MM. This earthquake fault is least likely to cause liquefaction related damage. There is the probability of 2.5 percent that an earthquake would occur on this fault within the next 100 years. The principal hazard to Burbank is ground shaking that would be

similar to that which occurred in 1971.

San Fernando Fault. There is a 39 percent probability that within the next 100 years a magnitude 6.5 earthquake could occur on this fault. This fault is classified as an active fault and is capable of generating an earthquake with the shaking intensity of 7.5 to 8.0 MM, similar to that experienced during the 1971 Sylmar Earthquake. This fault is located to the northwest of the City. Damage resulting from a maximum credible earthquake is expected to be moderate and probably less than that experienced during the 1971 Sylmar earthquake. This can be attributed to better construction quality, improved disaster response planning and seismic rehabilitation which has reduced the City's vulnerability.

Hollywood Fault. The Hollywood Fault is estimated to be capable of generating a magnitude 6.4 at a probability of 6.2 percent within the next 100 years. This fault is a reverse fault and therefore would result in a maximum credible earthquake that would have higher than anticipated accelerations and intensities resulting in a 10 to 10.5 MM. An earthquake on this fault would impact the southern part of the City. The liquefaction-prone area along the Los Angeles River would be subject to 10 to 10.5 MM that would result in liquefaction damage. Mid-rise and high-rise buildings in the Media District would be exposed to the effects of site amplification. The seismic intensities drop gradually across the City to the northwest, with most of the urbanized section of Burbank experiencing intensities greater than 9.0 MM. During the 1971 earthquake, buildings constructed of pre-cast concrete suffered significant structural damage from such levels of ground motion, especially in areas prone to liquefaction.

Verdugo Fault. The Verdugo Fault traverses Burbank through the Verdugo Mountains located in the northeastern section of the City. This Fault is located along the lower slopes of the Verdugos and in the alluvium just south of these mountains. It is generally considered as the main surface of movement along which the mountains have been raised to their present position. This fault has also been mapped on the surface in northeastern Glendale and at various other locations in Burbank. The fault branches into Stough Canyon (see Plate 1). The Verdugo Fault has a low probability of 6.2 percent of delivering a magnitude 6.7 (8-10 MM) maximum credible earthquake within the next 100 years. The potential effects of an earthquake with this intensity would be the destruction of most masonry and frame structures located on or adjacent the fault. Underground pipelines would be seriously damaged. Large landslides could occur, well-built bridges destroyed and rails would

be bent slightly. Destruction of the Thompson Memorial Hospital, Central Library, Fire Station 11 headquarters, City Hall and Municipal Services Building and much of the downtown Burbank area could occur if a quake should occur on this fault.

Raymond Fault. The Santa Monica Raymond Hill Fault is located six miles from the Burbank Civic Center and is capable of producing a 7.5 magnitude maximum credible earthquake. There is a very low probability (3.1 percent) that an earthquake on this fault will occur within the next 100 years.

Unnamed Faults. These faults, which are indicated with question marks on Plate 1 in the pocket, are part of a poorly understood system of basin faults. They may be active or potentially active. The locations of these faults as indicated on the map may also be inaccurate.

1. PROBABILISTIC AND DETERMINISTIC APPROACHES TO EARTHQUAKE HAZARD ANALYSIS

There are two analytical approaches to earthquake hazard analysis: the deterministic and the probabilistic. The traditional approach has been deterministic. Seismic parameters are determined for a given site based on the size of the maximum credible earthquakes expected on selected active and potentially active faults in the area. As stated previously, the maximum credible earthquake is the largest earthquake a fault is capable of generating, based on historical experiences with similar faults, fault lengths, and earthquake magnitudes.

The deterministic approach, therefore, gives the worst-case scenario, rather than evaluating the hazard of smaller but more frequent earthquakes. This method does not take into account at all the likelihood of a maximum credible earthquake occurring. Although the worst-case results of a deterministic analysis may be difficult to apply in real world planning situations, this method has been favored in the past because it is straightforward, disregarding uncertainties inherent to seismic parameters addressed in a probability analysis. A deterministic seismic analysis for a hypothetical building site in the City of Burbank is presented in Appendix IV.

The probabilistic method addresses the questions of how often and how strongly the ground will shake when

considering all possible earthquakes in the area. For a probabilistic analysis, the maximum probable earthquake is arbitrarily defined as an earthquake that may occur within 100 years. In certain cases, however, it may be important to use a time period of say 30 to 50 years to best represent the designed lifetime or importance of the structure being considered. A probabilistic analysis does not mean to imply that a maximum credible earthquake will not happen, only that the probability of its occurrence during the lifetime of the structure is a function of the life of the structure and the frequency of occurrence of that earthquake. A measure of risk is implicitly assumed.

Structural engineers and planners use the results of such a probabilistic analysis to define the level of ground motion acceptable (risk is implicit) for a given structure. Critical facilities can then be designed or retrofitted for that ground motion level which, within economic reason, best approximates the strongest predicted ground motion. The results of the probabilistic method can only be considered realistic if the return period of earthquakes of different magnitudes on potentially causative faults is known with sufficient certainty.

2. GROUND SHAKING HAZARD

Ground shaking refers to the ground vibrations produced by an earthquake. Many variables, other than distance from the earthquake source, affect the spatial distribution and character of ground motion that results from an earthquake. These variables include the size of the earthquake, the type of fault (e.g., strike-slip or thrust), the orientation of the rupture surface, the basin geometry and topography, and the subsurface and near-site geological conditions. Historical records show that acceleration amplitudes, frequency composition, and duration of both the horizontal and vertical components of ground vibration may vary widely in the Burbank area. Ground motion at the surface is influenced mostly by the interaction between the seismic waves and the local geology and site conditions.

Because of the many uncertain variables involved, predicting earthquake ground motion from purely theoretical models is not possible. However, empirical equations that describe the variation of certain earthquake ground motion parameters as a function of earthquake magnitude and distance have been

developed. These empirical equations, which are continuously being revised with new earthquake data, are currently used to predict the ground motion levels that may be generated by future earthquakes.

A knowledge of regional earthquake ground motion parameters, as they relate to structural damage in an area, is essential for earthquake hazard analysis. However, characterizing earthquake damage is very difficult because it requires predicting the interaction between ground motion and structures. A sophisticated model of the problem can be created, but it would be difficult, expensive, time consuming, and for most projects, not warranted.

The oldest and still very useful measure of earthquake strength is **seismic intensity**. Seismic intensity scales are subjective classifications based on observations of damage caused by past earthquakes that are used to describe the destructiveness of a tremor at a particular location. The scale most often used is the **Modified Mercalli (MM) Scale**. This scale has 12 levels of damage; the higher the number, the greater the damage. The MM Scale is reproduced in Figure 8 on page 42.

Earthquakes are also normally classified as to severity according to their **magnitude (M)**. In recent years most seismologists have abandoned the familiar *Richter scale* for determining the size of large earthquakes. The Richter scale estimates the magnitude of a quake by using a seismograph to measure seismic waves, the form of energy released by disruptions of rock deep within the earth. A three on the Richter feels like a large truck rumbling down the street; an eight is catastrophic. Richter magnitude is a logarithmic measure of the maximum motions of the seismic waves as recorded with a seismograph. *Moment magnitude*--an earthquake magnitude measurement very similar to the Richter measurement--measures the amount of energy released by the fault movement in relation to the fault area which broke. The magnitude of an earthquake depends on the length of the rupture on the fault. It is calculated by multiplying the area of the fault's rupture surface by the distance the earth moves along the fault. The magnitude of an earthquake depends on the length of the rupture on the fault. Scientists now prefer the more precise moment magnitude scale. The 1994 Northridge Earthquake had a magnitude of 6.8; the 1989

1. Tremor not felt.
2. Tremor felt by persons at rest or in upper floors of a building.
3. Tremor felt indoors. Vibrations feel like a light truck passing by; may not be recognized as an earthquake. Hanging objects swing.
4. Hanging objects swing. Vibrations feel like a heavy truck passing by, and the jolt feels like a heavy ball striking the walls. Standing cars rock. Windows, dishes and doors rattle. Glasses clink and crockery clashes. Wooden walls and frames crack in the upper range of scale 4.
5. Earthquake felt outdoors, and its direction can be estimated. Sleepers are awakened. Liquids are disturbed, some spilled. Small unstable objects are displaced or upset. Doors swing, closing and opening. Shutters and pictures move. Pendulum clocks stop, start or change rate.
6. Earthquake felt by everybody. Many are frightened and run outdoors. Persons walk unsteadily. Windows, dishes and glassware are broken. Knick-knacks and books fall off shelves; pictures fall off walls. Furniture moves or is overturned. Weak plaster and masonry D are cracked. Small bells in churches and schools ring. Trees and bushes are shaken.
7. Difficult to stand. Earthquake noticed by drivers of motor cars. Hanging objects quiver. Furniture is broken. Damage to masonry D, including fallen plaster, loose bricks and stones, cracks in tiles and cornices. Weak chimneys break at roof line. Some cracks in masonry C. Waves form in ponds, disturbing the mud at the bottom. Slides and caving in sand and gravel banks. Large bells ring. Concrete irrigation ditches are damaged.
8. Steering of motor cars is affected. Partial collapse of masonry C structures. Some damage to masonry B; none to masonry A. Fall of stucco and some masonry walls. Twisting and falling of chimneys, factory stacks, monuments, towers and elevated tanks. Frame structures, if not bolted to foundation, shift. Loose panel walls are thrown out; decayed pilings brake off. Branches brake off trees. Changes in flow or in temperature of springs or wells. Cracks in wet ground and on steep slopes.
9. General panic. Masonry D structures destroyed; masonry C heavily damaged, sometimes completely collapsed. General damage to foundations. Frame structures, if not bolted, shifted off their foundations. Serious damage to reservoirs. Underground pipes are broken. Conspicuous cracks in the ground. In alluvial areas, sand and mud are ejected, forming sand craters.
10. Most masonry and frame structures are destroyed. Most foundations destroyed. Some well-built wooden structures and bridges are destroyed. Serious damage to dams, dikes, and embankments. Underground pipelines are seriously damaged. Large landslides. Water thrown on banks of canals, rivers, lakes, etc. Sand and mud shifted horizontally on beaches and in flatlands. Rails bent slightly.
11. Rails bent greatly. Underground pipelines completely out of service. Many and widespread disturbances of the ground, including broad fissures, earth slumps and land slips in soft, wet ground. Sand- and mud-charged water ejected from fissures in the ground. Sea-waves (tidal waves or tsunamis) of significant magnitude. Severe damage to wood-frame structures, especially if near to the shock center. Severe damage to dams, dikes and embankments. Few, if any, masonry structures remain standing. Large, well-constructed bridges destroyed due to damage to their supporting piers or pillars. Wooden bridges are affected less.
12. Damage is nearly total. Lines of sight and level are distorted. Objects are thrown into the air. Great and varied disturbances of the ground, including numerous shearing cracks, landslides, large rock-falls, and numerous and widespread slumping of river banks. Fault slips in firm rock with notable horizontal and vertical offset. Water channels, both at the surface and underground are disturbed and modified. Lakes are dammed, rivers are deflected, waterfalls occur. The rolling effect of the seismic waves is actually seen at the ground surface.

Masonry A: Good workmanship, mortar and design. Reinforced, especially laterally, and bound together with steel, concrete, etc. Designed to resist lateral forces.

Masonry B: Good workmanship and mortar. Reinforced, but not designed to resist lateral forces.

Masonry C: Ordinary workmanship and mortar. Not reinforced or designed to resist horizontal forces.

Masonry D: Weak materials, such as adobe; poor mortar. Low standards of workmanship; weak horizontally.

These masonry types are not to be confused with the conventional Class A, B, and C construction types.

Figure 8: Modified Mercalli Intensity Scale

Loma Prieta Earthquake in northern California had a magnitude of 7.1. Because size classification are based on a logarithmic scale, a Magnitude 8 earthquake is not twice as big as a Magnitude 4 earthquake, but rather 10,000 times larger. Earthquakes have only one magnitude, but they have several intensities that generally decrease with increasing distance away from the source. Although both magnitude and seismic intensity scales are used in this report, seismic intensities best characterize earthquake hazards for the purposes of planning and decision making.

Response spectra values are most useful for engineering design purposes where accurate seismic parameters are necessary to predict realistic values of ground motion. Response spectra represent the actual amplitudes and frequency contents of the seismic waves generated by an earthquake as they interact with a structure at a specific location. The response spectra values are used in dynamic motion analyses required in certain cases by the 1994 Uniform Building Code.

Composite earthquake intensity maps are based on intensities generated by overlapping the predicted ground motions from all active faults in the region. These maps depict the highest intensity distribution expected at every location in the area, and are most useful in identifying the regions where hazard mitigation measures are necessary.

A series of seismic intensity maps for the City of Burbank, together with a detailed discussion of the methodology and reasoning behind selecting the causative faults used to generate the seismic intensity maps, can be found in Appendix II. Seismic intensity maps, to date, have only been used for general planning purposes.

a. Ground Shaking Hazard Analysis

The traditional practice of using equations to describe the variation of seismic parameters as a function of earthquake magnitude and distance is limited in application, unless the results of these analyses are used to generate strong ground motion maps. These maps are increasingly being used in urban planning to designate special land use zones in new developments, to establish special design standards for critical facili-

ties, and to prioritize retrofitting of potentially hazardous buildings. Current research on predictive ground motion mapping emphasizes the use of relationships to relate site response, as determined from actual seismograph records, to geotechnical site conditions.

A simple approach to predict the interaction between ground motion and structures is to use seismic intensities to map ground motion. Seismic intensity maps are generated by subdividing ground conditions into relatively similar seismic shaking units, generally based on geologic rock units. Predicted ground motion parameters, expressed in units from the Modified Mercalli Scale are then assigned to each geologic unit to create an earthquake scenario map. Earthquake scenario maps are developed for a hypothetical earthquake generated at a specific location. These maps, if used together with inventories of potentially hazardous buildings, can help identify areas most likely to be severely damaged during an earthquake. The maps can also be used to identify areas where response capability operations, such as heavy rescue operations, will be vital in case of an earthquake.

b. Uses and Limitations of Seismic Intensity Maps

There are several advantages to using seismic intensity maps for safety planning and emergency response. Programs aimed at retrofitting potentially hazardous buildings can be coordinated so that the areas expected to experience the most damage in an earthquake are dealt with first. Using seismic intensity maps, the relative potential of certain areas to experience higher earthquake-related losses can be estimated. In addition, emergency response priorities and responsibilities can be appraised for different earthquake scenarios. Evacuation routes can be selected in advance so that in case of an emergency these can be implemented immediately. Search and rescue operations can be planned for, and practiced, in areas where these are most likely to be needed in the event of an earthquake.

There are, however, limitations to using seismic intensity ground motion maps. Seismic intensity maps are most accurate in predicting damage from

high-frequency wave forms typical of a near-field earthquake. It is not yet possible to accurately model for far-field earthquake effects such as site amplification. These maps rely on empirical observations of past earthquakes to predict structural damage. Accurate knowledge of the quality and type of development in an urban area is necessary to increase the resolution of predictive damage from seismic intensity mapping programs.

c. Ground Shaking Hazard Management

The most effective seismic safety program for new developments is the enforcement of the seismic design provisions stated in the Uniform Building Code. Burbank, and most of southern California, is located in Seismic Zone 4 according to the ICBO Model Building Code adopted by state and local governments.

Conventional developments, such as residential tracts, are designed using peak ground accelerations and general lateral force procedures. These methods provide an adequate and economically-feasible safety margin for most conventional structures with simple plan design. The design of some structures, such as critical facilities, may require sophisticated seismic design methods, such as dynamic response spectra and time history analysis.

3. FAULT RUPTURE HAZARD

Earthquakes can cause large horizontal or vertical displacements of the ground surface along an active fault. Structures built across such a fault experience extensive damage in the event of a fault rupturing. To prevent this kind of seismic hazard from occurring, the State of California enacted the Alquist Priolo Special Study Zone (APSSZ) Act of 1972. Under this act, active faults and fault zones are identified and mapped throughout the state. In addition, development within an APSSZ must include geological studies prepared by a registered geologist, and building setbacks away from the fault must be defined and implemented.

Special criteria developed by the California Division of Mines and Geology to implement the APSSZ Act require evidence of proven or suspected displacements of Holocene age (0 to 11,000 years old) deposits to designate a fault as active. In addition to offset Holocene stratigraphy, youthful geomorphology and structural distortion of near-surface Holocene deposits are also considered strong evidence for inferring a high-risk of fault rupture.

Several faults in the County of Los Angeles have been designated as APSSZ by the California Division of Mines and Geology. Several other faults are currently considered potentially active. Potentially active faults, according to the APSSZ Act, are those which appear to have offset Pleistocene (two million years and younger) deposits, but have yet to be proven or disproved as having offset Holocene sediments. An important limitation of the APSSZ program is that mapping is regional. Consequently, certain faults may not be expediently designated as an APSSZ, and faults with ambiguous evidence of activity may never be designated an APSSZ. Because geologic relationships used to evaluate Holocene faulting can be obscured by the accumulation of stream deposits, erosion, or landsliding, an interpretation of risk can be problematic.

The designation of a fault as active, potentially active or inactive is largely dependent on the purpose and the requirements of the regulatory definition used. Although the Alquist Priolo definitions are generally applicable to conventional development, the siting and design of critical facilities usually require more stringent definitions of seismic activity.

a. Hazard Analysis

No APSSZ within the City of Burbank have yet been designated by the California Division of Mines and Geology. The California Division of Mines and Geology (CDMG), however, has documented probable fault activity in the Verdugo Fault Zone. Evidence for faulting in the Verdugo Fault Zone within the City limits ranges from well-defined scarps, to linear, discontinuous breaks in slope along the alluvial fan emanating from the Verdugo Hills. In addition, the U.S. Geological Survey has published several maps that show the Verdugo fault as active. Other faults,

including the North Hollywood fault and several unnamed faults, have been identified within or near the City of Burbank limits (see Plate 1, in pocket, and Figure 9 on page 48).

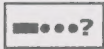
The potentially active faults in the basin lie under a deep layer of alluvium and have been mapped from groundwater barriers and gravity data. Because similar, previously unrecognized and underestimated fault structures were the loci of hundreds of surface breaks along the San Fernando Fault Zone in the 1971 San Fernando Earthquake, the faults in Burbank merit special attention in future studies. Evidence of recency of movement along these faults in southern and southwestern Burbank may be concealed by the substantially thick stream sediments deposited by the Big Tujunga Wash. The surface rupture potential for each fault, as shown in Figure 10 on pages 49 and 50 has therefore been inferred. Future investigations should be aimed at more accurately evaluating the risk of each fault rupturing during an earthquake, although due to the thickness of cover and the developed nature of the City, these issues may never be resolved. The North Hollywood fault poses a credible surface rupture risk. Figure 11 on page 51 shows a hypothetical cross-section of the City of Burbank that illustrates the subsurface distribution and geometry of the Verdugo fault, and of an unnamed basin fault.

The Verdugo Fault Zone occupies approximately 1,200 acres (Plate 1, in pocket). This zone can be expected to experience severe damage from ground shaking, ground deformation and differential settlement, as well as fault rupture in the event of an earthquake on the Verdugo fault. Most damage would be concentrated along the surface rupture trace of the fault.

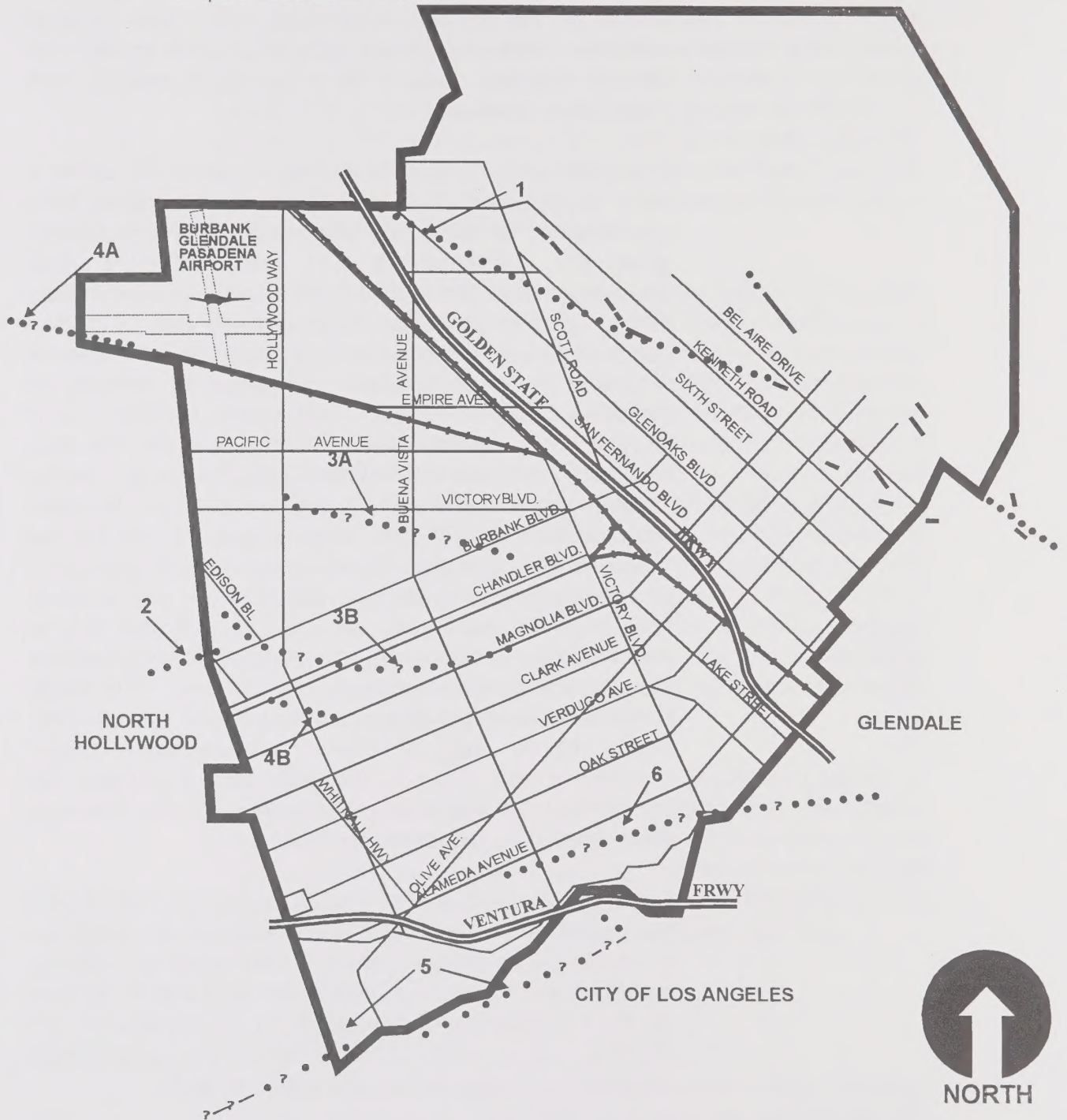
b. Uses and Limitations of Fault Zone Mapping

Several potential fault rupture hazards not currently recognized by the state-mandated APSSZ Act have

LEGEND



Active and potential active faults; solid where location is well established, dotted where concealed, and queried where location is uncertain.



CITY OF BURBANK ACTIVE & POTENTIALLY ACTIVE FAULTS

(The faults have been numbered to correspond to the numbers in Figure 10 on pages 49 and 50, which gives further information on each fault)

Figure 9: Active and Potentially Active Faults in the City of Burbank

Figure 10: Fault Rupture Hazard Assessment

Label (as shown in Figure 9.)	Fault Name	Geometric Aspects	Inferred Surface Rupture Potential	Evidence	Types of Development Requiring Site-Specific Investigations
1	Verdugo Fault Zone	Multiple strands in zone 1/2 to 1 km wide. Strikes N 50 to 70 degrees W. Inferred to dip 45 to 60 degrees NE. At least 20 km long.	High	Well-defined scarps and linear breaks in slope; strong gravity contrast along fault trace. (1)	Critical facilities and conventional development
2	Not named	Single strand, at least 6.5 km long. North side of fault is down-dropped.	Low to Medium	Ground water barrier; gravity data. (1)	Critical facilities
3a	Not named	Single strand, possibly 8 km long.	Low to Medium	Ground water barrier; gravity data. (1)	Critical facilities
3b	Not named	Single strand.	Low to Medium	Ground water barrier; gravity data. (1)	Critical facilities
4a	North Hollywood	Presumed single strand; vertical dip.	Medium to High	East to northeast-trending linear break in topography evident on 1901 and 1926 USGS quadrangle maps. Youthful deposits may have been offset. (1,2)	Critical facilities and conventional development
4b	Not named	Presumed single strand.	Low	Elevation change suggests axis of syndinal trough. (1)	Insufficient information (3)

(1) Weber et al., 1980

(2) Ziony et al., 1985

(3) Insufficient evidence to confirm the presence of a fault or structure. Not likely to result in surface rupture.

Label (as shown in Figure 9)	Fault Name	Geometric Aspects	Inferred Surface Rupture Potential	Evidence	Types of Development Requiring Site-Specific Investigations
5	Griffith (?)	Presumed single strand.	Low	Topographic lineament in line with Griffith fault. No subsurface evidence available to substantiate its presence. (1)	Insufficient information (3)
6	Not named	Presumed single strand. North block down-dropped (?) (1)	Low to Medium	Ground water and gravity data.	Critical facilities

(1) Weber et al., 1980

(2) Ziony et al., 1985

(3) Insufficient evidence to confirm the presence of a fault or structure. Not likely to result in surface rupture.

Figure 10: Fault Rupture Hazard Assessment (cont'd.)

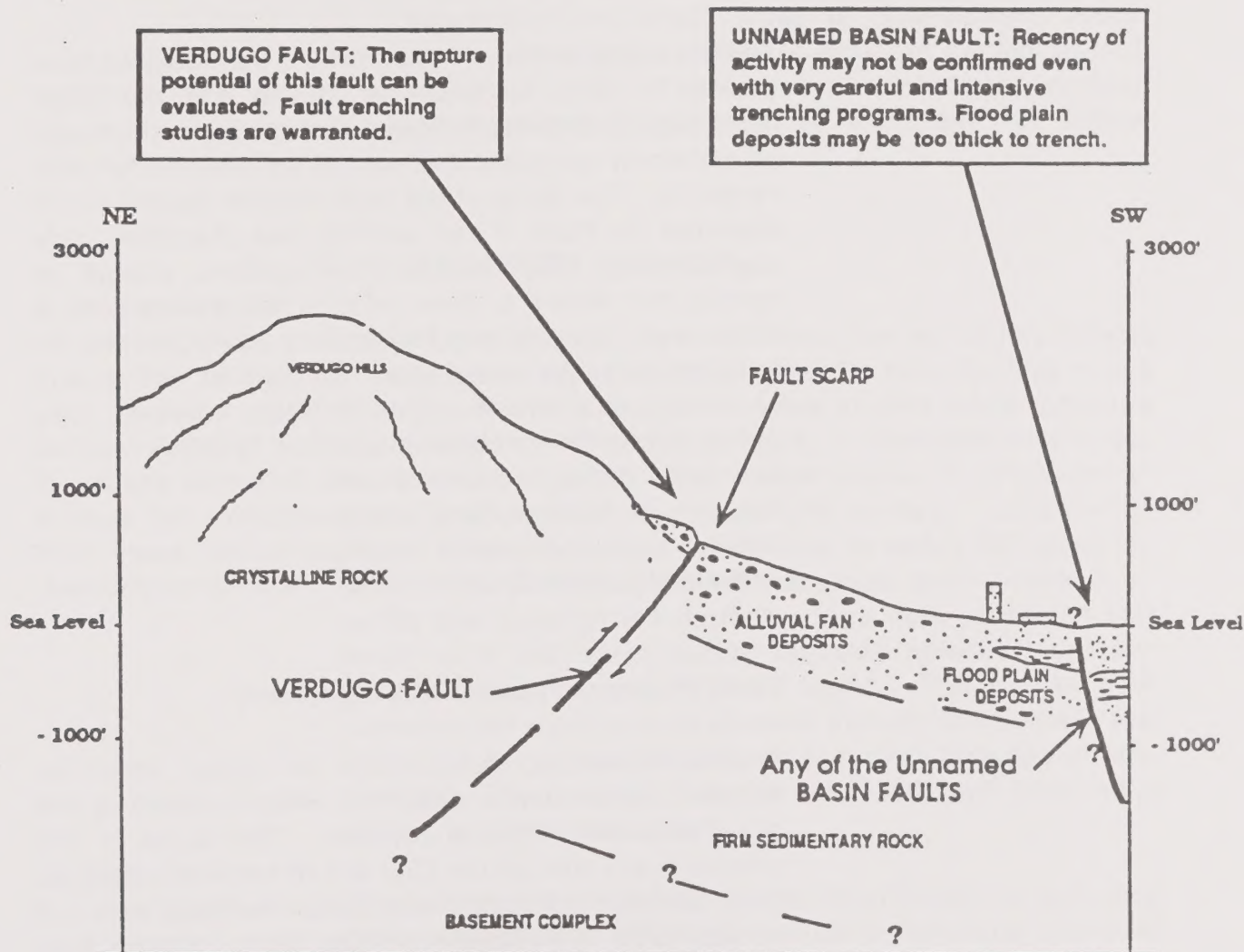


Figure 11: Hypothetical Cross-Section of Burbank with the Verdugo Fault

been identified in the City of Burbank and are shown in Plate 1 (in pocket). Because of limited information available regarding most of these faults, a conservative approach was selected to assess the fault rupture hazards. Plate 1 is intended to be of assistance in land-use planning decisions, specifically if applied to programs aimed at reducing property damages and increasing the public's safety. It is probable that the level of risk, or even location, of the basin faults will never be known with certainty.

The branching pattern of fault rupture that resulted from the 1971 San Fernando Earthquake and the 1994 Northridge Earthquake indicates that ground rupture can be extremely complex, and cannot be planned for with certainty. The limits of the fault rupture hazard zones depicted in Plate 1 (in pocket) are therefore only approximate. Site-specific investigations should be carried out where a more reliable risk assessment is warranted. Conventional fault safety strategies rely on building setbacks away from recognized active and potentially active faults. This strategy, however, may not be appropriate when siting critical facilities such as hospitals, dams, or chemical and industrial plants. If the risk of fault rupture is unacceptable for such a facility, a more adequate location, further away from active and potentially active faults, must be considered.

c. Fault Rupture Hazard Management

Potentially active faults, such as those found in Burbank, pose unique problems when evaluating the acceptable risk of fault rupture. The faults in the alluvial basin area of the City are of uncertain seismic risk. Conventional fault investigation methods may not be applicable in the study of these faults because they are covered by a deep layer of sediment. A fault trenching investigation in these cases generally does not provide any useful information regarding the fault's recency of activity. The risk of these faults rupturing during an earthquake, therefore, may not be fully evaluated. The acceptable risk from these faults is dependent on the sensitivity of the land use or facilities planned for this area. The risk of developing on these faults should be addressed on a site-specific basis. The

Community Development Department should consider the type of facility proposed, with its inherent acceptable risk, as part of their decision-making policies. Burbank has the option of implementing building and redevelopment regulations more conservative than those dictated in state guidelines. The extent and scope of these regulations depend on the level of risk the City is willing to accept given the uncertainties regarding the faults mentioned herein. Figure 10 (pages 49 and 50) includes a preliminary assessment of which types of development would require site-specific studies to evaluate the risk of fault rupture. In most cases, the expense of detailed investigations would only be warranted for critical facilities.

4. LIQUEFACTION HAZARD

Liquefaction is one of the most destructive secondary effects of seismic shaking. Liquefaction results from the loss of soil strength due to a sudden increase in pore water pressure during shaking. It occurs primarily in saturated and loose, fine to medium-grained soils, in areas where the groundwater table is 50 feet or less below the surface. Liquefaction occurs most often where groundwater is within 30 feet of the surface, but it may occur in areas where groundwater is up to 50 feet beneath the surface. High pore pressures that build up in sediments during repeated seismic vibrations cause the soil to behave as a liquid. The excess pore pressures are often pushed upward through fissures and soil cracks causing a water-soil slurry to bubble onto the ground surface. The resulting features are called sand boils, sand blows, or "sand volcanoes".

The reduction in soil volume due to densification or extrusion causes settlement which may result in failure of structural foundations and retaining walls. Substantial structures, such as multistory buildings or freeway interchanges, may settle up to several feet below grade or overturn in liquefied material (Figure 12 on page 55). As with fault rupture, liquefaction can impact utility, flood control, and transportation lifelines. Damaged roadways pose accessibility problems for emergency response vehicles and can complicate evacuation operations. Severed water distribution lines can also impair fire fighting efforts or, if associated with

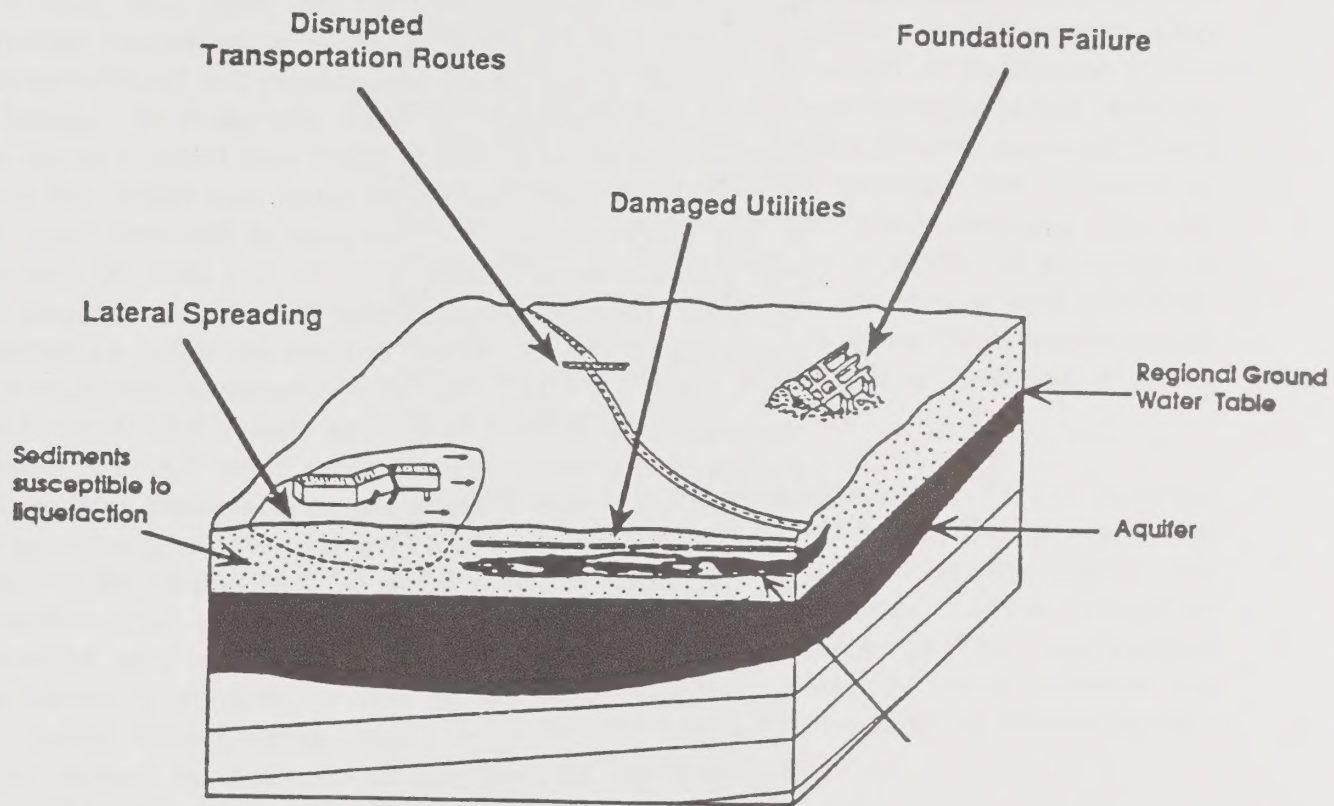
wastewater line breaks, may contaminate the drinking water supply. Lateral spreading, a particularly damaging form of liquefaction that results in shallow flow failures on gently-dipping ground, caused the destruction of the Juvenile Hall facility in the 1971 San Fernando Earthquake.

Modified Mercalli intensities as low as 7.0 can induce damaging liquefaction. A review of the seismic intensity data derived in this study indicates that the City of Burbank may experience this level of shaking from a variety of nearby earthquake sources. Given the potential impact of earthquake-induced ground failure, an assessment of areas prone to liquefaction is useful to urban and disaster response planners.

a. Liquefaction Hazard Analysis

For liquefaction to occur, three primary conditions need to occur: 1) a moderate to strong (M 6 or greater) earthquake that generates strong ground shaking; 2) shallow groundwater, within 50 feet of the ground surface; and 3) laterally extensive layers of loose, fine to medium-grained sandy soils within the saturated zone. A moderate to strong earthquake can be expected to occur just about anywhere in southern California. Therefore, liquefaction susceptibility studies concentrate on identifying those areas where loose, fine to medium-grained soils occur in conjunction with shallow groundwater levels. Because groundwater levels can and do fluctuate over time, the liquefaction susceptibility of an area can also change over time.

Areas prone to ground failure can be identified using one of several state-of-the-art procedures that have been developed for this purpose. Information has to be collected regarding: a) the distribution of youthful, cohesionless, granular surficial and subsurface sediments which are more likely to liquefy, and b) the location of shallow (50 feet or less) or perched (water trapped in sediments at a higher elevation than that of the regional water table) groundwater. This data is a necessary component of any hazard analysis, regardless of which procedure is used to identify the liquefaction-prone localities within the region.



(Liquefaction may occur where ground water is within 50 feet of the surface if the surface and subsurface sediments are susceptible to liquefaction. In the City of Burbank, perched ground water zones are known to occur within 50 feet of the ground surface. The regional ground water aquifers are about 150 feet below the surface.)

Figure 12: Liquefaction Hazards

Studies have shown that liquefiable ground conditions exist in the City of Burbank. In general, all of the area of Burbank west of the Golden State Freeway (I-5) is underlain by recently deposited sediments that may include potentially liquefiable layers (Zones 1 and 3). If groundwater levels in this area rise to within 50 feet of the ground surface, the sediments would have a moderate to high susceptibility to liquefaction. The liquefaction susceptibility of an area can also be evaluated based on the historical groundwater record. The highest water levels recorded in the San Fernando Valley were measured in 1944, the result of unusually high rainfall rates in 1941, 1943 and 1944 (Tinsley et al, 1985). In 1944, the water table was within 50 feet of the ground surface in the area of Burbank west of the Golden State Freeway. In the last 50 years, however, regional groundwater levels have dropped in response to the increased volume of water extracted from wells. A 1993 map of groundwater contours for the upper Los Angeles River area shows that in most of Burbank, the water table is more than 100 feet deep. The only exception is along the southwestern portion of the City, near the Ventura Freeway, where groundwater has measured at about 50 to 60 feet below the ground surface. Therefore, as long as there is continued extraction of groundwater in the upper Los Angeles River area, and we do not experience a series of unusually high rainfall years, groundwater levels in Burbank can be expected to remain at or deeper than 50 feet, with a resultant low to very low level of risk from liquefaction for most of the City. The recognized liquefaction-prone areas cover approximately 340 acres; 200 acres along and adjacent the Los Angeles River and 140 acres parallel to Interstate 5 (Plate 1, in pocket and Figure 13 on page 58).

The liquefiable (less than 30 feet to groundwater) and potentially liquefiable (30 to 50 feet to groundwater) area along Interstate 5 is used predominantly for general manufacturing, industrial and commercial purposes. Manufacturing zones generally include some hazardous facilities. Hazardous facilities, as defined by the Uniform Building Code, are buildings where explosives or toxic chemicals in quantities above state standards are used or stored. It is reasonable to assume that some of these facilities may be structurally deficient and/or

vulnerable to damage from strong ground motion, liquefaction or surface fault rupture. An earthquake generating medium to strong seismic intensities could cause a release of hazardous materials from these facilities.

There are several state legislative measures aimed at controlling hazardous materials. These measures include requirements for storage and handling, and development of a Risk Management and Prevention Plan (RMPP) for businesses. Although an evaluation of the structural stability of hazardous facilities is not required by the Fire Code, RMPPs require seismic evaluation and make recommendations for facilities that present an Acutely Hazardous Materials (AHM) accident risk. An assessment of the structural integrity of buildings in which hazardous materials are stored and handled, including storage tanks and other key nonstructural containment features, should be emphasized in areas prone to liquefaction.

The liquefaction-prone area adjacent to the Los Angeles River, which consists of approximately 140 acres, is the general location of the Saint Joseph Medical Center, the Warner Brothers Studios and Disney Studios, as well as several mid-rise commercial buildings. The most serious threat from liquefaction-related damages involves the Saint Joseph Medical Center due to its necessary role in emergency response.

The liquefaction-prone areas in the City of Burbank are shown on Plate 1 (in pocket) and Figure 13 on page 58.

b. Uses and Limitations of Liquefaction Susceptibility Mapping

Maps showing areas susceptible to liquefaction (Plate 1, in pocket, and Figure 13 on page 58) are useful for general planning purposes. Note that the limits of the liquefaction-prone areas are approximate. A liquefaction susceptibility map can be used to do the following.

LEGEND

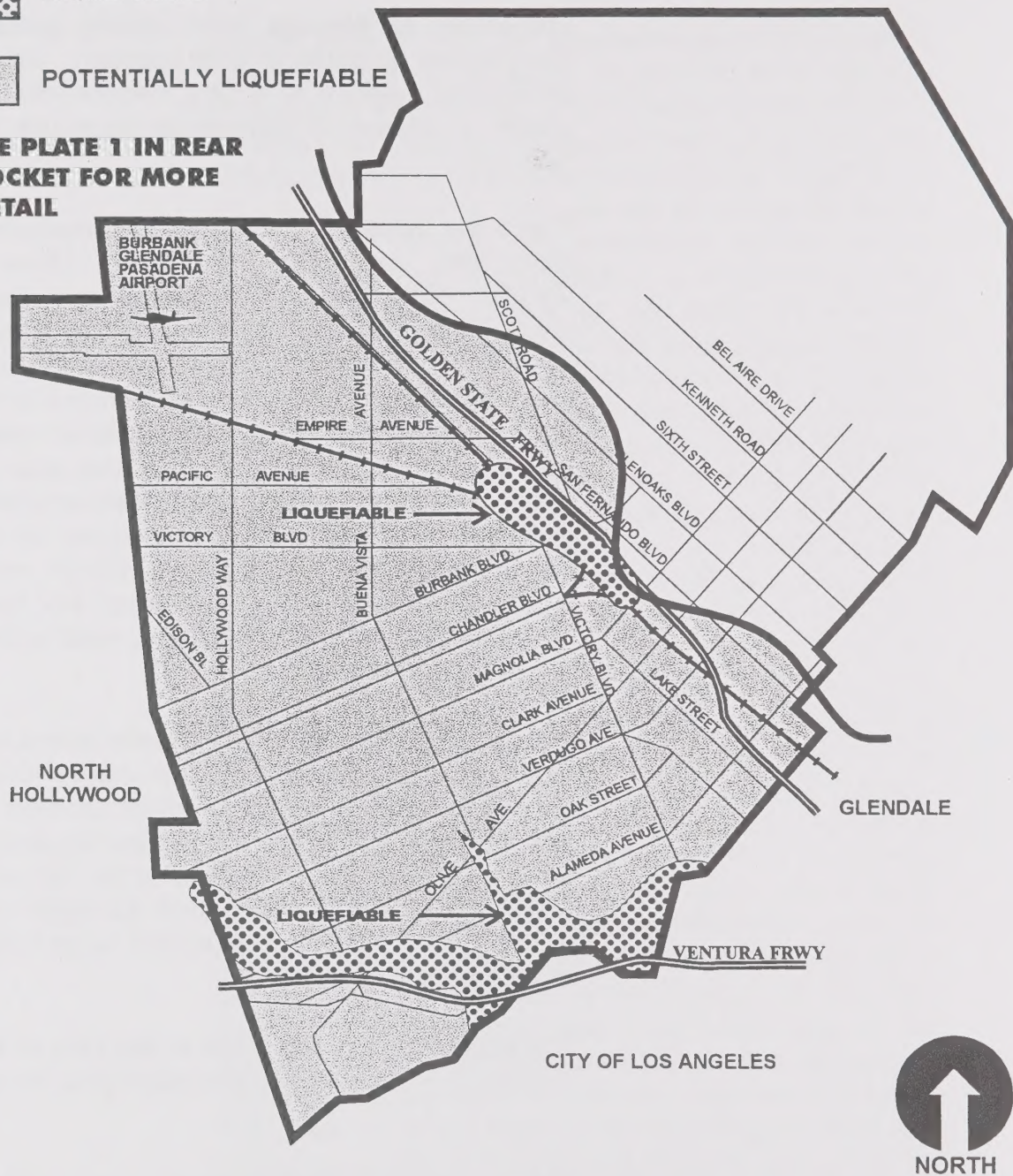


LIQUEFIABLE



POTENTIALLY LIQUEFIABLE

**SEE PLATE 1 IN REAR
POCKET FOR MORE
DETAIL**



**CITY OF BURBANK
LIQUEFIABLE AREAS**

(Refer to Plate 1 in pocket for a more accurate representation of these areas.)

Figure 13: Approximate Locations of Liquefiable (L) and Potentially Liquefiable (PL) Areas in Burbank

- Identify where site-specific liquefaction investigations are required for development proposed within or near the liquefaction-prone areas identified. Studies for conventional development should evaluate the liquefaction potential of sediments within 30 feet of the surface; studies for critical facilities should be more conservative and extend to 50 feet from the surface.
- Identify and develop programs to repair or strengthen lifelines and other infrastructures located in liquefaction-prone areas.
- Prioritize the abatement or mitigation of hazardous and critical facilities such as bridges, freeway interchanges or overpasses located in liquefaction-prone areas;
- Identify those sites relatively more suitable for the siting of critical facilities;
- Identify those areas with the highest potential for emergency response action in the event of an earthquake;
- Plan access and evacuation routes to and from critical facilities;
- Identify areas where groundwater monitoring and management would be appropriate; and
- Identify those areas where additional research and mapping would be appropriate to assess the risk of liquefaction.

A liquefaction susceptibility map has a number of inherent limitations, including the following.

- Lateral variations in the physical properties and susceptibility of the alluvial materials cannot be represented adequately;
- Seasonal fluctuations in the groundwater table and perched water zones, as a response to increased precipitation, change the configuration of the isobaths shown;
- The data on shallow groundwater was limited; therefore, the location of the isobaths are only

- approximate;
- All localized perched water bodies, especially within the flood plain deposits, may not be adequately represented.

c. Liquefaction Hazard Management

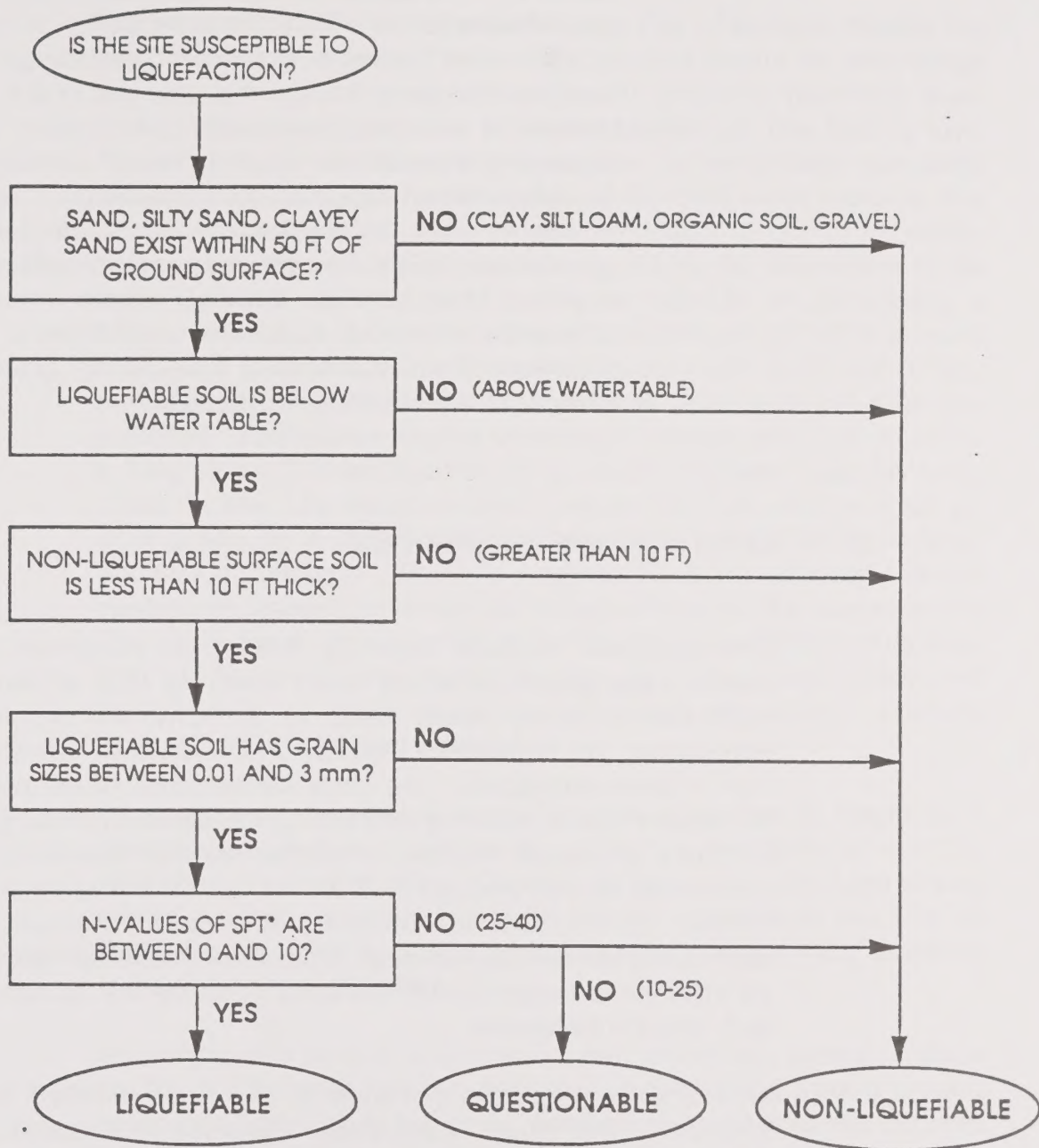
A site-specific study is the only practical way of determining conclusively if a site is liquefiable. Figure 14 on the following page shows a generalized geotechnical model for investigating the liquefaction potential of alluvial sediments. Several other appropriate methodologies are available as well.

The state building code requires that the potential for liquefaction be eliminated in cases where critical facilities are situated in a designated liquefaction-prone area. The Building Code does not however provide specific mitigation measures. Several mitigation alternatives exist, including:

- Replacing existing soil with nonliquefiable material;
- Emplacing permeable columns of gravel that provide a release mechanism for the buildup in water pressures that cause liquefaction;
- Densifying the soil using any of several types of dynamic or vibratory compaction equipment; or
- Lowering the water table using dewatering wells.

Deep pilings may be appropriate for facilities located in or near stream channel areas, while more elaborate methods may be appropriate for large subdivisions or industrial facilities. Some building codes require structural mitigation of buildings over 3-stories high or with over 2,000 pounds per square foot of structural load if liquefaction hazards were encountered during the geotechnical investigations. Structural mitigation of smaller buildings and private residences is usually left to the discretion of the owner or developer.

METHOD FOR LIQUEFACTION ANALYSIS



* N is the number of blows required to advance a sampler a distance of one foot into the soil. In a Standard Penetration Test (SPT) the sample is driven using a 140-pound drop hammer.

Figure 14: Method for Liquefaction Analysis

Groundwater management practices can have an impact on shallow and perched groundwater levels. Likewise, seasonal increases in precipitation can elevate groundwater levels. Thus, the liquefaction vulnerability of a site can fluctuate seasonally, or change through time, as a response to regional changes in the levels of shallow or perched groundwater. Any policy aimed at regulating liquefaction hazards must consider these variables. When designing critical facilities it is prudent to plan for such fluctuations. For example, monitoring groundwater levels through observation wells may be a cautious, but justified strategy where groundwater levels are known or suspected to fluctuate. This is especially true in the area crossed by groundwater barriers shown in Plate 1 (in pocket).

D. EARTHQUAKE SCENARIOS

The Modified Mercalli Intensity Maps for maximum credible earthquakes generated along faults near the City of Burbank (in Appendix II) show which areas of the City will hypothetically experience the highest intensities, and therefore, worst damage from a given earthquake. The maps are designed to be most useful for urban disaster planning and during the decision-making process of siting a critical facility. Because damage resulting from an earthquake on the Verdugo fault will be concentrated on a different section of the City of Burbank, than say, damage from an earthquake on the San Fernando fault, these maps can also be used as effective emergency-drill planning tools by fire fighters, police, and hospital personnel.

Of the faults included in Appendix II, four were selected for special analysis in this study. Earthquake scenarios and seismic intensity maps for the City of Burbank were generated for the Verdugo, San Fernando, Hollywood and Sierra Madre faults. These causative faults either have relatively high probabilities of generating maximum credible earthquakes within 100 years or are near-field earthquake sources, and as such, their high-frequency ground motion effects are more accurately portrayed in seismic intensity maps. Because these faults vary in their location relative to the City, each will have a distinct pattern of earthquake damage. The seismic intensity maps for each of the four hypothetical earthquakes should be used for general planning purposes only and not for

specific building requirements. Site-specific studies are required to adequately characterize seismic design parameters.

The proximity of the Verdugo fault to the City of Burbank makes the earthquake scenario on this fault particularly useful for long-range urban planning and worst-case disaster response planning, even though the actual likelihood of an earthquake on this fault is low. The other faults considered in this section for earthquake scenarios present various levels of seismic risk. A far-field earthquake on the San Andreas Fault has the greatest probability of occurring within the next 100 years. This fault, some 40 to 50 kilometers away from Burbank at its closest point, is capable of generating a Magnitude 7.5 to 8.0 earthquake. This event would result in peak horizontal ground accelerations ranging between 0.02 and 0.16g, and would most likely damage bridges and mid- to high-rise buildings. Earthquake studies indicate, however, that the effect of a Magnitude 7.5 earthquake on the San Andreas Fault on most cities in the Los Angeles Basin would be less severe than an earthquake on a closer fault and would be restricted to isolated pockets of damage. The San Andreas Fault was not used for an earthquake scenario in this study because other faults, closer to the City of Burbank, are capable of generating near-field earthquakes that will have a greater impact on the City. In addition, near-field earthquakes are more accurately portrayed on seismic intensity maps than far-field earthquakes.

An analysis of the seismic intensity maps presented in Appendix II provides information regarding the present vulnerability of the City of Burbank to earthquakes. General conclusions have been drawn based on these maps and specific action items that the City of Burbank may want to pursue or implement as preliminary planning tools have been identified.

An earthquake on any of the active and potentially active faults in southern California has the potential of generating strong ground motions in the City of Burbank. Each of these earthquake sources would produce distinct damage patterns. Several faults, potentially more damaging than the San Andreas fault, occur near Burbank. The Verdugo fault, for example, is believed capable of generating a maximum credible earthquake of Magnitude 6.7. This earthquake would generate peak horizontal ground accelerations of approximately 0.5g in Burbank. Such a near-field earthquake would damage structures such as single-story buildings preferentially. Appendix IV includes a list of all known, potentially causative faults in the region, the magnitude of the maximum credible earthquake each one can generate, and the shortest distance from a

hypothetical site near the center of Burbank to each fault.

Some faults have a higher probability of generating a maximum credible earthquake in the next 100 years than others. The probability of an earthquake occurring within a given period of time is calculated using the best known value of long-term movement of the causative fault (its slip rate), and historical seismicity records. In cases where this information has not been determined, (due to limited field studies of the fault, or due to limited recent seismic activity on that fault), the calculated probabilities are very general estimates at best. Figure 15 on the following page shows the probability, ranked as high, moderate or low, of a maximum credible earthquake occurring on any of a select group of faults. Figure 15 ranks these same faults according to how much potential damage they can cause in Burbank as a result of a maximum credible earthquake. The appendices list the probability of a maximum credible earthquake occurring in 100 years on most of the known, potentially causative faults in the region. These values were determined using a probabilistic ground motion analysis.

The San Fernando Fault has a high probability of generating a Magnitude 6.6 earthquake in the next 100 years. Such an event would result in seismic intensities up to 7.5 MM in the City of Burbank, similar to those experienced during the 1971 San Fernando Earthquake. A maximum credible earthquake on the Sierra Madre Fault would generate seismic intensities up to 8.5 MM in the City of Burbank; however, studies indicate that this fault has a low probability of generating such an earthquake in the next 100 years. The Hollywood Fault is estimated to have a low probability of generating a Magnitude 6.4 earthquake in the next 100 years. A worst-case scenario for this event, however, indicates that the southern part of the City may experience intensities up to 10.0 MM. To date, there is no conclusive data with which to gauge the probability of a maximum credible earthquake occurring on the Verdugo Fault. For worst case planning purposes, we have assumed that the Verdugo and Hollywood faults have similar probabilities of generating a maximum credible earthquake. The maximum credible earthquake on the Verdugo Fault has been estimated to be of Magnitude 6.7, resulting in worst case intensities up to 8.0 MM in the City.

A	FAULT NAME	Likelihood of Occurrence	Mcr
	San Andreas (Mojave Segment)	High	7.5
	San Andreas (San Bernardino Mountains Segment)	High	7.5
	San Fernando	Moderate	6.5
	San Andreas (Carrizo Segment)	Moderate	8.0
	Elsinore	Moderate	7.1
	Whittier	Moderate	7.3
	Newport Inglewood	Low	6.8
	Offshore Newport Inglewood	Low	6.8
	Hollywood	Low	6.4
	Verdugo	Low	6.7
	Sierra Madre	Low	6.4

B	FAULT NAME	MM Intensity in Burbank	Mcr
	Verdugo	9-10	6.7
	Hollywood	>9	6.4
	Sierra Madre	8-9	6.4
	San Fernando	>8	6.5
	Newport Inglewood	8	6.8
	San Andreas (Carrizo Segment)	7	8.0
	San Andreas (Mojave Segment)	7	7.5
	Whittier	7	7.3
	San Andreas (San Bernardino Mountains Segment)	7.5	7.5
	Elsinore	5-6	7.1
	Offshore Newport Inglewood	5-6	6.8

Impact on Burbank of a selected group of active and potentially active faults. A) shows the maximum credible earthquake (Mcr) each one of these faults is predicted capable of generating, and the likelihood of such an earthquake occurring within the next 100 years. The probabilities were ranked as high, moderate and low as follows: high - greater than 50%, moderate - 10 to 50%, low - less than 10%. B) shows the same faults ranked according to their potential impact on Burbank based on the Modified Mercalli Intensity value that such an earthquake is estimated to be capable of generating in the City. Refer to the Appendix for more information regarding these and other faults.

Figure 15: Probability and Intensity of Selected Faults in Burbank

The CDMG and the USGS consider the Verdugo Fault zone a surface rupture hazard. The fault, however, is not yet recognized as an active fault by the APSSZ Act. Future fault investigations near the defined fault traces, which are the probable locus of potential surface rupture, may establish unequivocally whether Holocene sediments (less than 11,000 years old) have been offset. This condition is required by the APSSZ to designate a fault as active. Meanwhile, the fault should be considered as if it were active for planning and development purposes, until geologic studies can resolve the issue.

The Northridge Earthquake proved that southern California is particularly vulnerable to another, newly recognized seismic hazard--hidden faults. Called blind thrust faults, they move differently from the San Andreas, whose sides rip past each other horizontally, rupturing the ground with a visible scar. Blind thrust faults, by contrast, slope at shallow angles toward the surface. When they break, one side thrusts upward, and, as in the Northridge Earthquake, the earth above them shudders with especially violent upward jolting. Blind thrust faults usually do not rupture the surface. Therefore, the only evidence of their existence may be mountain ranges that rise above them. During the Northridge Earthquake, for instance, Oat Mountain, near its epicenter, was lifted up and northwest 18 inches. Yet the fault that created the havoc was unmapped, confirming a growing suspicion among geologists about the mountain-rimmed Los Angeles Basin.

The Northridge Earthquake was a reminder that there are unknown, obscure faults everywhere beneath Los Angeles. One of them can create a magnitude 6.7 quake; if two or more break together, a much larger earthquake--perhaps even a 7.5 would occur.

E. VULNERABILITY OF THE CITY TO SEISMIC HAZARDS

This section summarizes Burbank's earthquake vulnerability in terms of critical facilities such as reservoirs, hospitals and transportation routes. Figure 1 on page 8 shows the seismic vulnerability of selected critical facilities in Burbank.

1. WATER STORAGE FACILITIES AND SUPPLY NETWORK

In the event of a major earthquake, the aqueducts supplying water to our region--Colorado, California and Los Angeles aqueducts--could sustain damage, causing interruptions in the water supply, possibly for weeks or even months. The numerous major reservoirs in the southern California region provide ample storage to meet demands during the time required for repair; however, damage to water transmission lines, local storage reservoirs and pumping plants, as well as local distribution systems, will affect water availability and pressure. The absence of electrical power for extended periods will, in some areas such as the hillside, preclude water deliveries where pumping is necessary, even though conveyance facilities may be intact. Even if water distribution systems are effective in delivering water, this water may not be potable due to contamination. Many areas could be dependent on tanker trucks to provide their basic needs.

Page 21 in Section III provides a discussion of the City of Burbank water system; Figure 4 on page 22 shows the major feeders and reservoirs.

a. Reservoirs

The statutes governing dam safety in California are implemented through the California Department of Water Resources. Section 8589.5 of the California Code requires that inundation maps and emergency response plans be prepared for dams or debris basins affected by state safety regulations. However, the Department of Water Resources jurisdiction includes only those dams 25 feet or more in crest height or dams with storage capacities of 50 acre-feet or more. As a result, many potentially-hazardous levees, railroad and highway fills, circular and elevated tanks, and federal dams could be exempt from the Water Code.

Burbank Reservoir Nos. 1, 4 and 5 are under state regulations; their inundation areas are shown on Plate 1 (in pocket). The aspects which are considered when evaluating the relative threat of dam failure and inundation posed by these reservoirs include:

- Age and quality of construction;
- Type of construction;
- Seismic design standards for ground shaking;
- Threat of liquefaction to earthen fill embankments; and
- Threat of fault rupture to dam abutments or to foundations of concrete and earthen fill dams.

Burbank Reservoir No. 1 is covered to protect the stored, potable water from contamination. This cover also protects the dam from overtopping during heavy storms, generally the most frequent cause of earthen dam failure (Figure 16 on the following page). The reservoir was built in 1928, before earthquake construction provisions were added to the Uniform Building Code and was rehabilitated in 1989. Rehabilitation included reconstructing the upper 20 feet of slabs, installing new columns and footings for the roof, resealing all slab joints and installing a soil embankment monitoring system. The rehabilitated reservoir is reportedly judged to be "grossly stable" under today's standards.

Records show that most concrete dams perform well during large earthquakes. Nevertheless, the concrete tank structures of Burbank Reservoir Nos. 4 and 5 were built in the late 1940's and early 1950's, prior to the development of sophisticated engineering design methods that incorporate any knowledge of fault rupturing and ground shaking hazards. In the event of a catastrophic earthquake, concern should be focused on the stability of the foundation and abutments in these and similar concrete dam structures (Figure 16).

In coordination with the Department of Water Resources, the Burbank reservoirs are inspected 1 to 2 times a year for cracks, leakage and other signs of deterioration that may result in failure. All facilities have operational foundation underdrains that are monitored monthly for increases in leakage. In addition, the Public Service Department operates a system of groundwater monitoring piezometers around Burbank Reservoir No. 1. These monitoring devices are used to record the rate of seepage, which is continuously examined to check for signs of piping in and around the

BURBANK RESERVOIRS 1,4, and 5

Dam Name	Storage Capacity (In acre-feet*)	Type	Year of Construction
Burbank Reservoir No. 1	21	Earthen fill	1928/1989**
Burbank Reservoir No. 4	34	Reinforced Concrete	1955
Burbank Reservoir No. 5	95	Reinforced Concrete	1949

* Acre-feet: The volume of one acre in area that is one foot in thickness.

**Burbank Reservoir No. 1 was rehabilitated in 1989.

Causes of dam failure for dams of earthen/rock fill and concrete construction between 1900-1975

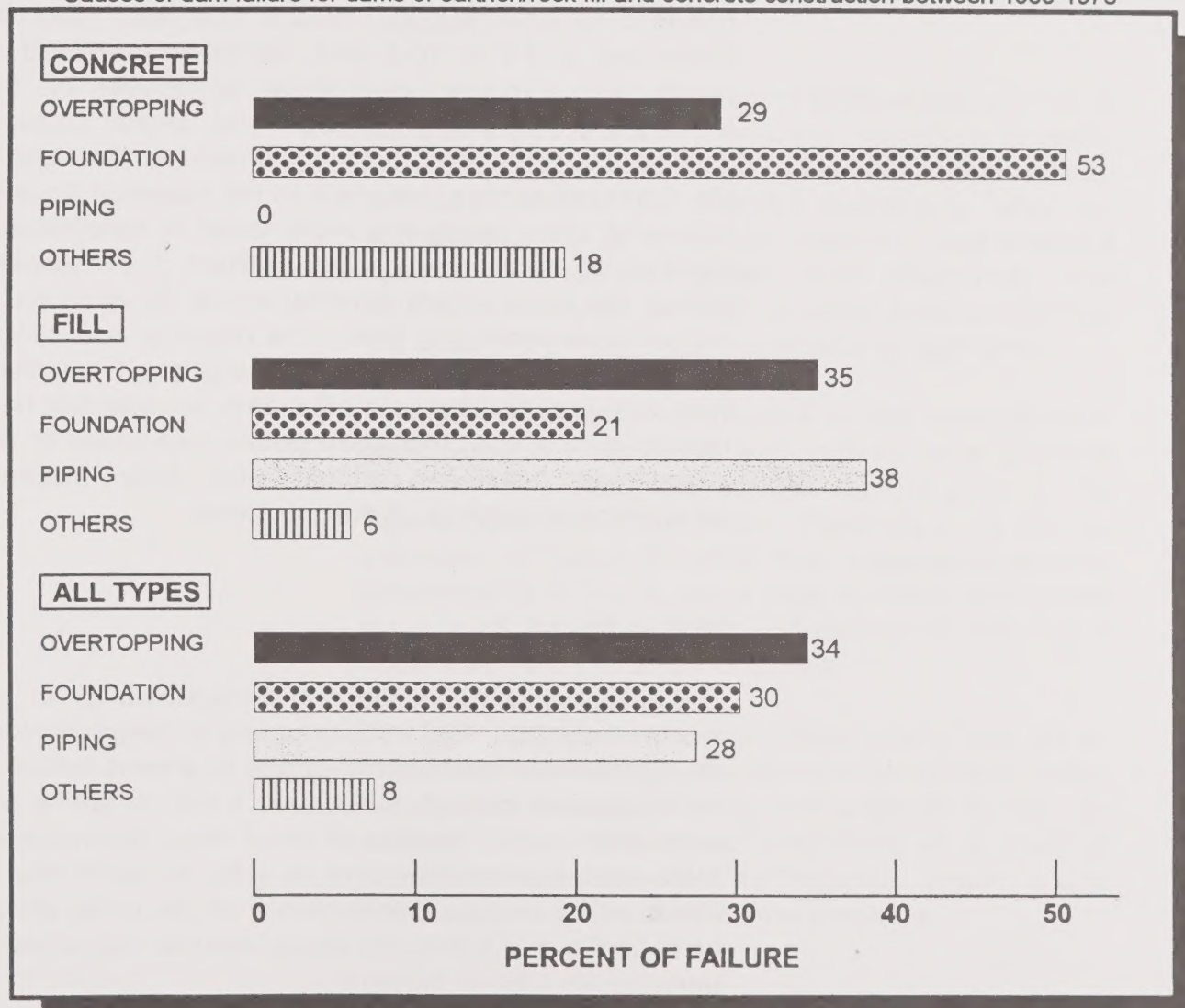


Figure 16: Burbank Reservoirs and Common Causes of Dam Failure

reservoir. Anomalous saturation conditions, if detected could indicate incipient cracks in the embankment or foundation. All of these preventive measures are used to keep emergency action plans from ever needing to be implemented.

A maximum credible earthquake on the Verdugo Fault poses the greatest potential threat of dam failure for Burbank Reservoirs Nos. 1, 4 and 5. Although in compliance with state standards for dam safety, worst-case planning should not preclude the possibility of dam failure and inundation. Where a degree of uncertainty remains, informed perception and engineering judgment need to be balanced to interpret the risk. Seismic intensities of 10 to 10.5 MM, as those predicted to result from a maximum credible earthquake on the Verdugo fault, could damage the three Burbank reservoirs. Reservoir No. 1 could also be damaged if the saturated earthen materials in the reservoir liquefy. Failure of these reservoirs could result in catastrophic flooding of areas downstream. Plate 1 (in pocket) shows the areas where flooding would be expected if any of these reservoirs fails. The ongoing dam safety program and the City Disaster Emergency Operations Plan are vital components of a dam or reservoir risk-reduction program. Increased public awareness of the worst-case possibility should also help facilitate emergency operations, if ever required.

b. Water Tanks

The safety of water tanks is the responsibility of the local jurisdiction. Old or inadequately-designed water storage tanks located in areas prone to ground failure or strong ground motion could pose a risk of failure and consequent minor flooding of small areas downstream. Many water tanks date from as early as World War II. Site-specific structural evaluations of the tanks should be carried out to assess the actual seismic risk of water tanks in the City of Burbank.

c. Water Supply Network

A critical aspect of the City's water system is the post-earthquake fire suppression capability of the water distribution system. Approximately 85 percent of the water distribution network relies on cast-iron pipelines. These pipes can easily break if liquefaction or ground settlement occurs, or if the ground moves as a result of fault rupture. The pipes can also be damaged by high amplitude ground waves. City of Burbank Public Services Department has been replacing cast-iron pipes with ductile iron pipes. In addition, all 4-inch pipes and smaller are being replaced and made more earthquake resistant.

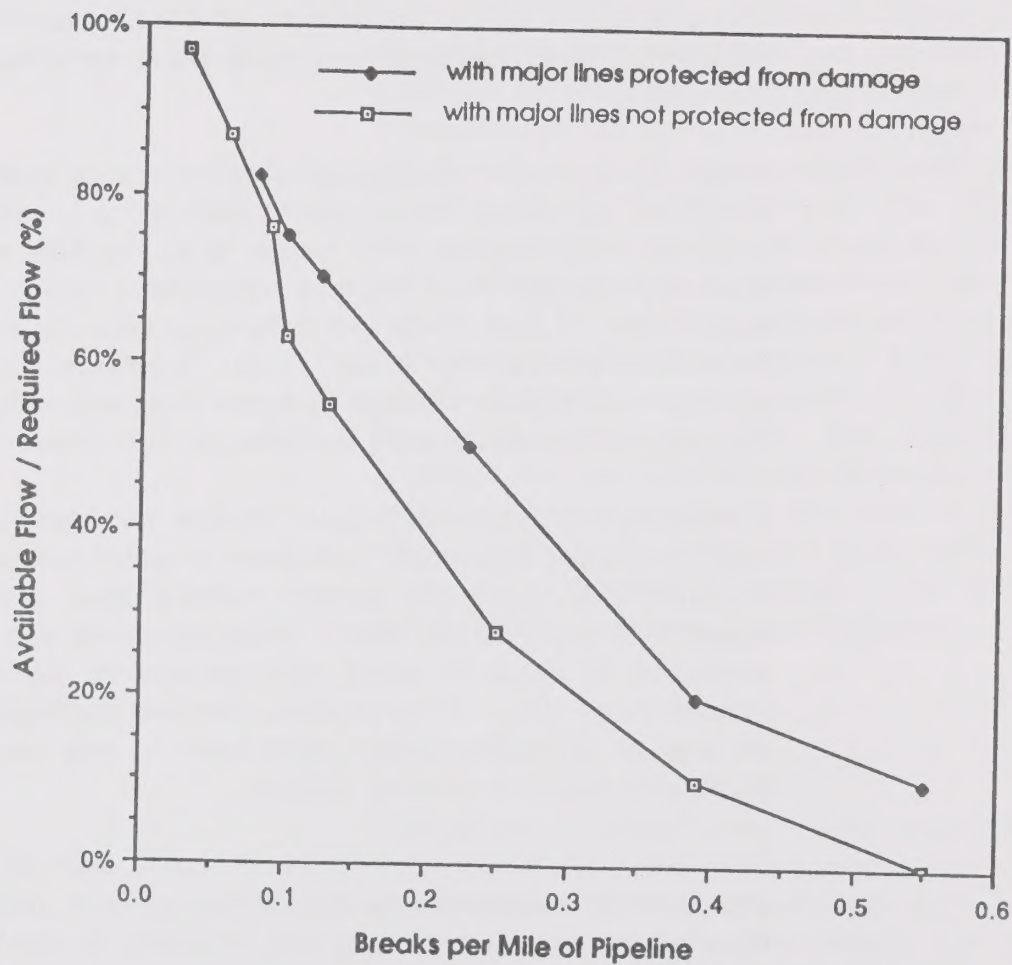
Breaks in the water distribution pipeline and or loss of electricity can result in significant reductions in water pressure. Diminished peak water load supplies can seriously hamper fire control operations after an earthquake. Figure 17 on the following page shows a computer simulation graph that illustrates how earthquake-induced damage to water lines can reduce the peak water load supply available to fight fires.

A maximum credible earthquake on the Verdugo fault could result in a significant reduction in water pressure if water lines along the surface rupture zone or the liquefaction-prone areas break. Pipelines could also be expected to break in areas that experience seismic intensities of 10+. A worst case scenario earthquake on any of the other faults considered in this report could also result in pipeline breaks.

Far-field earthquakes should have much less of an impact on the water supply distribution system, unless liquefaction is induced along and adjacent to the Los Angeles River. Differential settlement as a result of moderate and near-field earthquakes would create localized emergency water flow problems.

2. HOSPITAL FACILITIES

As a result of the 1971 San Fernando Earthquake, the State of California passed the 1972 Hospital Act. This act



Example of a computer simulated assessment of the effects of an earthquake on the fire suppression capability of the City of San Francisco's auxiliary water system.

Figure 17: Fire Suppression Capability of an Emergency Water System

preempts the primary responsibility for hospitals from local control, and charges the state with regulatory review responsibility. Although the legislation conveys the importance of keeping a hospital facility functioning after a major earthquake, the Act does not require that a hospital remain undamaged. The design and construction standards implemented as a result of the 1972 Act are considerably more rigorous than those employed in the construction of older, pre-1972 hospitals. State law requires that general acute care hospitals be upgraded to current earthquake design standards if undergoing voluntary rehabilitation.

The two main hospital facilities in the City of Burbank are:

- St. Joseph Medical Center
- Thompson Memorial Medical Center

St. Joseph Medical Center is an acute care hospital with a trauma center, licensed for about 600 beds. The usual patient census at this facility is less than 300, with the staff and support materials on hand for that number. Additional patient care units can be opened and staffed with a 12 hour lead time. The hospital facility consists of several multi-storied buildings with construction dates ranging from 1947 to 1992. The new Robertson Tower meets the most critical construction standards for seismic safety, but the older portions of the facility do not. Financial constraints have precluded the establishment of a seismic retrofit program for the facility, however a nonstructural damage mitigation program is in its infancy.

St. Joseph Medical Center is located roughly three and one-half miles away from the Hollywood and the Verdugo faults, respectively. An earthquake on either fault could produce seismic intensities at the hospital site as high as 9.5 to 10. The hospital is located just outside of a liquefaction-prone area designated along the Los Angeles River, therefore, there is a risk of structural damage to this facility from liquefaction. Evacuation routes and emergency entrances and exits to the hospital may be nonfunctional if these cross liquefaction-prone areas near the river. Underground utilities serving the facility may also be rendered nonfunctional. Any of these possibilities could impair the vital function of the facility in an emergency. The most severe threat to the hospital buildings will be strong ground shaking.

Unnamed Fault No. 6 (see Figure 9, page 48) has been mapped through the northeastern corner of the St. Joseph Medical Facility. As discussed previously, the earthquake recurrence, and the potential for surface rupture on this fault, have not been established. There is the real possibility, given the uncertainties regarding this fault, that the facility could suffer damage to its buildings and/or supporting infrastructure from an earthquake on this little known fault.

Vencor Hospital is an acute care hospital which functions as a long-term respiratory treatment facility. The hospital's licensed bed capacity is 95, with a usual patient census of 40 people. Vencor does not maintain a trauma center; however, during an emergency, vacant beds could be occupied. Acquired in August 1997, the hospital consists of several mid-rise buildings and is currently being remodeled. Seismic retrofit will be incorporated into the remodel as required by state law. The hospital is located less than one mile away from the trace of the Verdugo Fault. Movement on the Verdugo Fault represents the worst-case scenario for disaster response planning purposes. The alluvial fan underlying the hospital may amplify the seismic waves generating intensity values of MM 9.5 to 10. Damage to the hospital would include failure of nonstructural building components such as partitions, ceilings, and equipment. Structural damage to older, pre-1972 buildings should also be expected. The risk of surface rupture at the hospital facility from the Verdugo Fault appears to be low. A major concern would be the continued operation of the hospital in the event that off-site public utilities are rendered nonfunctional. Fallen building debris blocking emergency entrances and exits would also cause access problems.

Both hospital facilities have detailed disaster plans which deal with seismic hazards, as well as other disasters and emergencies occurring at the hospital or to which the hospital must respond.

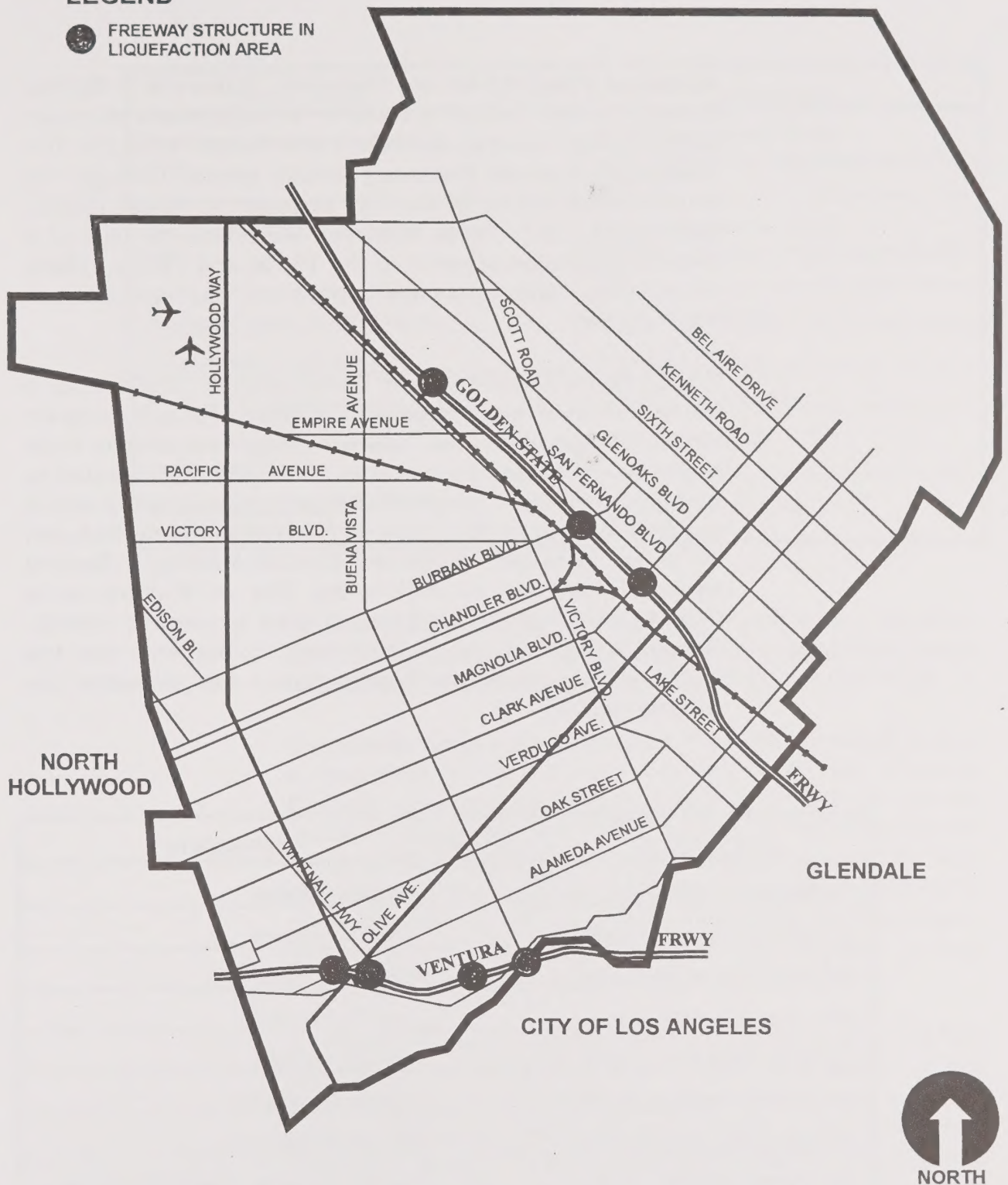
3. TRANSPORTATION/CIRCULATION FACILITIES

Primary transportation facilities in the City of Burbank include the freeway and surface-street networks, the railroad system, and the Burbank-Glendale-Pasadena Airport (Figure 18 on page 75).

LEGEND



FREEWAY STRUCTURE IN
LIQUEFACTION AREA



CITY OF BURBANK MAJOR FREEWAYS & VULNERABILITY TO LIQUEFACTION

Figure 18: Vulnerability of Freeways in Burbank to Liquefaction

Burbank is traversed by two freeways: Interstate 5 (Golden State Freeway) which travels in a north/south direction parallel to San Fernando Boulevard and Routes 134/U.S. 101 (Ventura/Hollywood Freeway) which travels through the southwestern corner of the City through the Media District (see Figure 18). These freeways were built as part of a freeway expansion program in the 1950s and 1960s. Many of the ramps, crossovers and bridges are also from this pre-1971 period.

The California Department of Transportation (Caltrans) is in the midst of a major statewide freeway retrofit program aimed at upgrading the seismic design of certain state highway and freeway structures. This phase is directed at numerous pre-1971 single-column structures located within Los Angeles County that have an inferred relatively high-risk of being damaged by severe ground shaking. Several freeway structures located in the City of Burbank were identified by Caltrans as being in need of seismic retrofit. The following is a list of structures in Burbank that the California Department of Transportation has evaluated for seismic retrofit.

BRIDGE NAME	PHASE	COMMENTS
Pass Avenue overcrossing	1	Retrofit complete
Alameda Avenue overcrossing	1	Retrofit complete
Hollywood Way overcrossing	1	Retrofit complete
Olive avenue overcrossing	1	Retrofit complete
California Street overcrossing	1	Retrofit complete
Bob Hope Drive undercrossing	1	No retrofit required
Riverside Drive undercrossing	1	No retrofit required
Providencia overhead--Right	1	Retrofit complete. Superstructure only, substructure by SR 650.
Providencia overhead--Left	1	Retrofit complete. Superstructure only, substructure by SR 650.
San Fernando undercrossing	2	
Alameda Avenue undercrossing (four separate bridges)	2	Retrofit complete

BRIDGE NAME	PHASE	COMMENTS
Providencia Avenue overhead, right	2	To be completed by 12/97. Substructure only, superstructure by SR 599.
Providencia Avenue overhead, left	2	To be completed by 12/97. Substructure only, superstructure by SR 599
Verdugo Avenue undercrossing	2	No retrofit required
Olive Avenue overcrossing	2	No retrofit required
Magnolia Boulevard overcrossing	2	Construction complete.
Burbank Blvd./Buena Vista overcrossings	2	No retrofit required
Buena Vista/Winona undercrossing	2	Construction complete

Retrofit work has been completed on all Phase 1 projects, and it is the Department of Transportation's goal to complete retrofit work on all Phase 2 projects by the end of 1997.

Earthquake damage at the Burbank-Pasadena-Glendale Airport is expected to be the result of strong ground motions. Damage may include broken windows in the air control tower, and downed air traffic control computer systems. Unnamed Fault No. 2 (see Figure 9, page 48) crosses through the western end of the airport. Should this fault be the locus of ground rupture as a result of an earthquake on this poorly-understood system of basin faults, the western runway would most likely be rendered nonfunctional.

The Southern Pacific Railroad service lines transverse the City parallel to Interstate 5 along the southern border of the former Lockheed Aircraft Corporation site and the Burbank-Glendale-Pasadena Airport along Vanowen. Liquefaction may damage the rail lines along Empire Avenue. It is anticipated that rail lines may be closed for up to 72 hours due to roadbed failure caused by liquefaction. Liquefaction is also anticipated to occur in the western San Fernando Valley portion of this line. In addition to the threat of liquefaction, a derailment, or a hazardous material incident resulting from a derailment, could prolong the amount of time the rail lines are closed and possibly cause the evacuation of the surrounding area. Metrolink and Amtrak service which runs

along these lines would be interrupted as the result of a derailment, rail damage or rail obstruction. Metrolink commuter rail proved to be a critical resource in bringing employees, as well as commuters from other areas who use Burbank as a transit hub, into the City after the 1994 Northridge Earthquake when the freeway system was not functioning.

4. NATURAL GAS FACILITIES AND PETROLEUM PIPELINES

The natural gas utility network in the City of Burbank is operated by the Southern California Gas Company (SoCal). SoCal embarked on a retrofitting program of their steel and cast iron pipelines 4-inches in diameter and smaller after the 1971 San Fernando Earthquake exposed the vulnerability of the gas distribution system. About 90 percent of the distribution supply pipeline replacements have been done with plastic polyethylene pipe. The new transmission and distribution trunk lines are made of welded .375- to .500-inch thick steel pipe. Although larger pipes have generally performed well in most earthquakes, leaks in 20-inch semi-high pressure lines in Oakland, 12-inch lines in Hollister, and 8-inch lines in Santa Cruz were reported after the 1989 Loma Prieta Earthquake. These damaged pipes resulted, at worst, in service disruption; however, the possibility of fire from ignited natural gas leaks should not be overlooked. Gas leaks can also occur at the connection between the distribution supply mains and the pipes leading to individual buildings and residences. Ignition of natural gas vapors from home appliances such as unanchored gas heaters and gas-fired water heaters is a principal cause of earthquake-related fires.

The natural gas infrastructure for the City of Burbank consists of the Olive and Magnolia Power Plants, gas transmission and distribution lines and the supply network (see Figure 6 on page 28).

A maximum credible earthquake on the Verdugo fault could result in numerous damaged and leaking mains, valves, and service connections associated with the small-diameter gas supply system underlying surface streets. Damage would be concentrated along and adjacent to the predicted zone of rupture that extends northwestward from easternmost Sunset

Canyon Drive to the point where the fault leaves the City at its juncture with Interstate 5. Pipes not made with earthquake-resistant plastic would most likely break and leak, causing fires along these streets. Similar scenarios are possible along and adjacent to the liquefaction-prone areas along Interstate 5 and the Los Angeles River, especially as a result of a maximum credible event on the Hollywood fault. Damaged house line connections, overturned water heaters, and malfunctioning electrical utilities could also cause fires throughout the City.

In the event of an earthquake, the Gas Company recommends that people do not turn off their gas if they do not hear or smell a gas leak. This is because, in such an event, natural gas could be the only source of energy; also, it could take up to three months for the Gas Company to turn all of the gas lines back on if everybody shut them off.

The gas distribution trunk lines in the City of Burbank are shown in Figure 6 on page 28. The 8-inch trunk lines along Oak Street do not cross any known liquefaction-prone areas. The 6-inch trunk line along Hollywood Way may be susceptible to breakage where it crosses the liquefaction-prone zone along and adjacent to the Los Angeles River. The trunk line following Burbank Boulevard is also vulnerable to ground failure in the vicinity of Interstate 5. The 30-inch transmission line along Glenoaks Boulevard could be damaged as a result of fault rupturing between Scott Road and Buena Vista Avenue.

A petroleum fuel pipeline also crosses the City of Burbank. Damage to this pipeline, as a result of an earthquake, would most likely cause localized contamination and disruption of service. There is also a risk of fire as a result of damage to these lines.

5. ELECTRICAL POWER FACILITIES

The principal elements of the electrical power system include power generating plants, natural gas lines supplying the generating plants, transmission switching stations and distribution substations, overhead and underground high-voltage transmission lines, and small emergency power generators. The City of Burbank owns two power plants with a combined generating capacity of 233,000 kilowatts.

Additional power is purchased from various sources, and delivered over the Los Angeles Department of Water and Power (LADWP) system, through an interconnection at Los Angeles Receiving Station "E" located on Whitnall Highway near Burbank Boulevard. A detailed discussion of Burbank's electric system can be found on page 23 in Section II. Figure 5, page 25, shows the location of all major electric facilities.

Above-ground substations and transmission lines, high-voltage transformers, circuit breakers and ceramic insulators, are susceptible to damage from high frequency ground motion from a near-field earthquake. Seismic intensities as low as that of the 6.8 Northridge earthquake can seriously disable this segment of the electrical network system. Unless ground failure occurs, power generating plants generally experience only slight damage during an earthquake, even when exposed to seismic intensities as high as 9.0.

Damage to the Olive and Magnolia Power Plants or to the electrical power transmission facilities as a result of a San Fernando or Sierra Madre fault earthquake scenario would probably not severely impair the City's power distribution system other than causing a short term blackout. Power sources outside the area of strong ground motion should be able to channel needed power to the City. The transmission network can easily be rerouted to restore power to most areas. Critical facilities should be able to function on back-up power while energy is restored to the affected areas. Severely impacted noncritical facilities should be able to rely on back-up power sources, including batteries and generators, for up to three days. Priority would be afforded to power restoration of hospitals, and other emergency service facilities.

An earthquake scenario on the Verdugo or Hollywood fault would probably disable the major substation operated by the Los Angeles Department of Water and Power (LADWP) (Figure 5 on page 25). The projected earthquake intensities of 9+ would cause extensive systems failure throughout the City of Burbank. Given that the surrounding subregional network is essential to reroute power to the City, damage to these transmission facilities would determine how long it would take to restore power. Restoration of power through other substations can be delayed as much as a few days or weeks depending upon the degree of damage.

The natural gas and fuel lines that feed the Olive/Magnolia Power Plants may be damaged by liquefaction. Inspection and repair of these lines, if they are damaged, could take longer than three days.

Damage to the Burbank City power plant and its ancillary facilities in affected areas can be expected to reduce generating capacity. The potential impact of this reduction in local output is lessened, however, by the availability of power from other sources outside the affected area and by the reduction in consumer demand that will occur. Immediate concerns will focus on repairs necessary to restore power to areas of greatest need such as hospitals, public health and safety, water pumping stations, sewage treatment facilities, etc. Major restoration problems include repairs necessary to route power through the major substations, restoration of damaged and collapsed transmission line towers, reactivation of equipment at local substations, and replacement of fallen poles, burned transformers, etc.

All electrical lines are supposed to de-energize automatically if electrical flow is interrupted; however, isolated incidents of energized lines on the ground should not be discounted. Fallen transmission lines can drain vital utility manpower resources since each line has to be checked to verify that it does not pose an electrical shock or fire hazard.

When such events occur, the Public Service Department's response will be coordinated through the City's Emergency Operations Center and in accordance with PSD's Emergency Systems Restoration Procedure. This document instructs personnel as to their responsibilities and what actions they must take in the event of power failure caused by earthquake or other natural disaster.

6. WASTEWATER DISPOSAL SYSTEM

The Burbank Water Reclamation Plant is located on West Chestnut Street adjacent the Burbank Western Flood Control Channel in the middle of the City. About 320 miles of pipeline carry the sewage generated in Burbank to the Reclamation Plant's wastewater treatment facilities. Some of the reclaimed water is used in the cooling towers at the City's Steam Power Plant as well as for landscape irrigation in various places in the City; the remainder of the reclaimed

water is then discharged into the Burbank Western Flood Control Channel. The Water Reclamation Plant lies in an area identified as being susceptible to liquefaction; this means that during an earthquake, the ground movement under the facility may render part or all of the wastewater treatment facility inoperable. Most of Burbank's sewage flows to the Burbank Water Reclamation Plant by means of gravity; only a small portion of the City's wastewater needs to be pumped into the plant. This means that after an earthquake, even if there is no power in the city, the sewage will continue to flow to the treatment facility via a system of pipelines, assuming the pipelines are intact. In the event that the Burbank treatment facility is partially or totally unable to treat the accumulating sewage, it has two options: to divert the untreated sewage to the Los Angeles North Outfall if the bypass lines are unaffected, or to let the untreated sewage flow into the Flood Control Channel via the plants storm drainage system. Normally, under contract with the City of Los Angeles, Burbank diverts a small portion of its sewage to the Los Angeles Hyperion Treatment Plant system via the North Outfall. In the event of an emergency rendering the Burbank Treatment Facility inoperable, Burbank may be able to divert all or part of its untreated sewage directly into the North Outfall; this however is only possible if the Outfall is not damaged and the Burbank pipeline system needed to carry the diverted sewage to the Outfall is not damaged. If sewage cannot be treated at the Burbank facility or diverted to the North Outfall, it may be necessary to let the untreated sewage flow into the Burbank Western Flood Channel and disinfect it with chlorine if possible. In the event of such a release into the Flood Control Channel, public notices are issued and reports made to the Los Angeles County Public Works Department, the Regional Water Quality Control Board and other regulatory agencies.

Burbank's vast network of sewer pipelines was constructed, for the most part, in the 1930's and 40's and consists primarily of clay pipes. These pipes are maintained by the Public Works Department and are monitored using video cameras which travel along the sewer lines underground. Severe shaking and ground instability brought on by a large earthquake can break or crack these pipes causing seepage of raw sewage into the soil and possible groundwater contamination. Public health regulations require that underground water and sewer lines be laid a distance apart and that the water lines be laid above the sewer lines; this

is to protect against contamination of drinking water in the event that both pipelines are broken.

A significant amount of electricity is needed to run the wastewater treatment facility and to pump sewage along the pipes in certain areas of the city. When a power failure occurs, either as the result of an earthquake or other disaster, the wastewater treatment facility is unable to function. The facility does not have an on site alternate power source; it relies on power generated by the City power plant or electricity imported from the statewide grid system. An on-site electrical generating system which would be used only in the event of a major emergency is considered not to be cost effective due to high capital investment costs, space constraints and stringent and costly air quality requirements of such a system required by the Air Quality Management District. Following an earthquake, the wastewater treatment facility may be without electricity, and therefore inoperable, for several days until local power is restored or the regional grid system is restored and the transmissions system repaired. At present the wastewater treatment facility is served by one electrical substation; should this substation not be able to deliver the necessary power the facility has no power. Planning studies are underway to provide service to the wastewater treatment facility from two separate electrical substations so that in the event that one is non-functional, the other may still be able to supply the necessary electricity.

Chlorine is still the primary disinfecting agent used in the wastewater treatment process. This toxic chemical is carefully regulated and a detailed "Risk Management and Prevention Program" for the handling of sulfur dioxide and chlorine at the plant has been prepared and submitted to the Burbank Fire Department for review and approval. In addition, continuous air monitoring systems are located in the chemical storage and application facilities for detecting any leaks. Tanks containing toxic chemicals are strapped down and concrete walls surround them. Recent studies which looked at replacing chlorine with an Ultra Violet Ray (UV) disinfection system found this alternative method to not be cost effective.

In the event of an emergency, such as an earthquake, the Wastewater Treatment Facility is linked to Burbank's EOC by means of telephone. An alternate communications system would ensure contact with the EOC in the likely event that

the telephone system will not be functioning following a large scale earthquake.

7. POTENTIALLY HAZARDOUS BUILDINGS

The California state legislature enacted the Unreinforced Masonry (URM) Building Law in 1986 (Chapter 250, Statutes of 1986; SB 547 Alquist; Government Code Section 8875 et seq.) which requires that a complete inventory of URM Buildings be completed by January 1, 1990. The law calls for the identification and development of mitigation programs for URM buildings with load bearing walls that support the floors and roof, and for buildings with URM infilled walls. Although historical buildings and warehouses with few occupants (unless they are used to store emergency supplies) are exempt from the identification phase, the Seismic Safety Commission recommends that these buildings be reviewed for adequacy with respect to seismic hazards (Section 37602 of the California Health and Safety Code).

As of 1990, the City of Burbank was one of only 22 jurisdictions in the County of Los Angeles that had enacted a seismic upgrading ordinance. The ordinance establishes "minimum standards for structural resistance for all buildings in the City except detached single-family residences and detached multifamily residential buildings containing five or fewer dwelling units". The ordinance is aimed at pre-1934 buildings with unreinforced masonry bearing walls. Buildings with URM infilled walls and deficient electrical, plumbing, mechanical, and fire safety features are not addressed in the ordinance. The City identified 51 masonry buildings and scheduled them for mandatory abatement; as of 1995, most had been brought into compliance. The City of Burbank has also made significant progress in retrofitting essential buildings (hospitals, emergency facilities, etc.), and high-risk structures (with greater than 100 person capacity). The Seismic Safety Commission also recognizes other building types with a history of poor performance during past earthquakes. Concerns for owner liability and public safety suggest that safety programs may be directed toward these building types in the future. The Seismic Safety Commission recommends that proactive safety programs be concerned with the following building types (in addition to buildings with masonry infilled walls not yet covered by the City of Burbank seismic safety upgrading ordinance):

- Buildings with tilt-up concrete construction;
- Nonductile concrete frame buildings with inadequate, or no steel reinforcement;
- Certain buildings with architectural irregularities, such as those with long spans, minimal amount of interior shear walls, or irregular shapes;
- Buildings with weak "soft-stories";
- Dilapidated, or improperly maintained buildings, and buildings weakened through inadequate modification;
- Mobile homes;
- Older single-family residences; and
- Buildings with interior and exterior nonstructural hazards.

Buildings with deficient electrical, plumbing, mechanical or fire safety features could also be included in the Seismic Safety Commission list above. Seismic safety hazards and risk increase with the age of the building.

Predictive seismic intensity maps cannot identify which structures will be severely damaged in the event of an earthquake, unless detailed knowledge of site-specific structural deficiencies are included as part of the study. Unless ground failure occurs, the following generalized summary of anticipated damage could result from both near-field and far-field earthquakes.

- Pre-1934 masonry buildings which have not been retrofitted will experience most of the structural damage in a major near-field earthquake (Deppe, 1988). Although retrofitting these buildings would decrease the total number of collapsed structures, significant damage could still be incurred by retrofitted buildings.
- Massive pre-1972 concrete buildings and structures can be expected to experience more damage than similar buildings with more recent designs that incorporate steel reinforcement (EERI, 1986). Pre-1971 commercial buildings with tilt-up concrete construction, if not retrofitted, are also prone to structural damage, especially if subject to foundation distress because of liquefaction. Both near-field and far-field earthquakes can damage non-ductile or tilt-up concrete buildings, the extent of the damage depending on the size and shape of the structure.
- Pre-1972 multistory buildings with a structural design weakness in one or more floors (soft-story) would sustain

significant damage, or even collapse (EERI, 1986) as the result of a significant earthquake.

- Houses built before the 1952 Uniform Building Code was implemented and have not been rehabilitated are more likely to slip off their foundations as a result of strong ground shaking. Near-field earthquakes will generate the strong ground shaking associated with this type of damage.

F. EARTHQUAKE HAZARD MITIGATION

The City of Burbank is a heavily urbanized community covering an area of approximately 17.1 square miles. Except for hillside areas, most of the City is fully developed. Urbanized land uses include low- to high-density residential, industrial and general manufacturing, and various types of commercial development. There are several hazard reduction techniques which can be used in the City of Burbank. The following are planning tools that already are or can be employed in Burbank to deal with seismic and related hazards:

- Building and Fire Codes Enforcement
- Seismic Overlay Zoning
- Building Safety-- Hazardous Building Abatement
- Hazard Reduction Incentives
- Lifeline (infrastructure) Development Standards
- Real Estate Disclosure
- Post-Earthquake Reconstruction Ordinance or Policy
- Public Education

Figure 2 on page 9 is a Hazard Analysis and Management Checklist which gives an overview of hazards facing Burbank and areas of risk management. Figure 20 on page 95 presents hazard reduction programs for various types of development in each of the seismic zones in Burbank (as shown in Plate 1 in the rear pocket).

1. BUILDING AND FIRE CODES ENFORCEMENT

Burbank, as most of southern California, is located in Seismic Zone 4 of the Uniform Building Code (UBC) which has the most restrictive regulations. The project design and review provisions and performance standards defined in the Uniform Building and Fire codes constitute hazard reduction measures that are incorporated into all new developments. The State of California prescribes mandatory seismic hazard provisions in the Uniform Building Code. For the most part, these guidelines exemplify performance standards and procedures developed by the International Conference of Building Officials (ICBO). Seismic guidelines have their origin in recommendations developed by the Structural Engineers Association of California (SEAOC) and by Applied Technology Council, a federally-subsidized research group. Local governments must amend their regulatory codes to conform with state requirements every three years. Technically, according to state law, local governments may adopt more stringent code standards only when based on special needs posed by extraordinary, climatic, geographic, or topographic circumstances unique to the jurisdiction.

The UBC defines special standards for the structural design of critical, essential, and hazardous facilities, including requirements for dynamic analyses, using response spectra and time histories of specific sites. The UBC also provides a framework for efficient use of probabilistic analyses. Combined with newly revised static force procedures for conventional development, these structural design analyses offer practical, state-of-the art techniques for modeling dynamic earthquake forces. Special fault and liquefaction investigations and design standards for future development and redevelopment can be implemented by local governments to augment Building Code provisions in specially delineated hazardous areas. Plate 1 (in pocket) provides a delineation of fault and liquefaction hazards for such purposes for the City of Burbank.

Effective enforcement of the Building Codes must be supported by suitable in-house technical expertise responsible for project review to verify compliance with seismic design standards.

Building and fire codes are not retroactive unless specifically indicated or in the case of a life/safety issue. Seismic hazard

reduction measures can be used to increase the safety of existing development. Hazard reduction measures range from immobilization of gas-fired heaters to retrofitting or strengthening of buildings or structures. Those programs can be encouraged through special tax incentives, special development waivers for appropriate renovation, reduced legal liability or public recognition (see Figure 19 on page 90 and Figure 20 on page 95).

The UBC requires the reinforcement of masonry structures. In Burbank, most structures of this type are concentrated in the downtown Burbank Village area. In 1990 Burbank City Council passed an ordinance which includes standards and regulations to classify and bring these structures into compliance. The Community Development Department, Building Division, is responsible for a comprehensive compliance and monitoring system. The program called for code compliance for high risk buildings by December 1991 and for lower risk buildings by April 1993. Almost all of the 51 buildings identified have been brought into compliance. As an incentive to compliance, plan check and inspection services were offered to property owners free of charge. Very few structures remain which are not in compliance with seismic safety standards.

2. SEISMIC HAZARD OVERLAY

Zoning codes prescribe permitted land uses within delineated districts or zones. Building height and setbacks, building bulk, lot coverage, density, and types of allowed land use activities are defined for these districts. Although applicable only to future development, zoning overlays can be administered to provide supplemental seismic standards and regulations for existing development and redevelopment, particularly infilling of the existing urbanized areas and in areas where special seismic risks have been or will be identified. Special earthquake hazard reduction standards are designed to operate in addition to existing zone provisions. Burbank does not make use of a special seismic hazard overlay, but rather enforces the UBC Citywide. Should the Verdugo Fault be proven to be active and the area designated as a Alquist Priolo Special Study Zone, a seismic hazard overlay would be appropriate for this area.

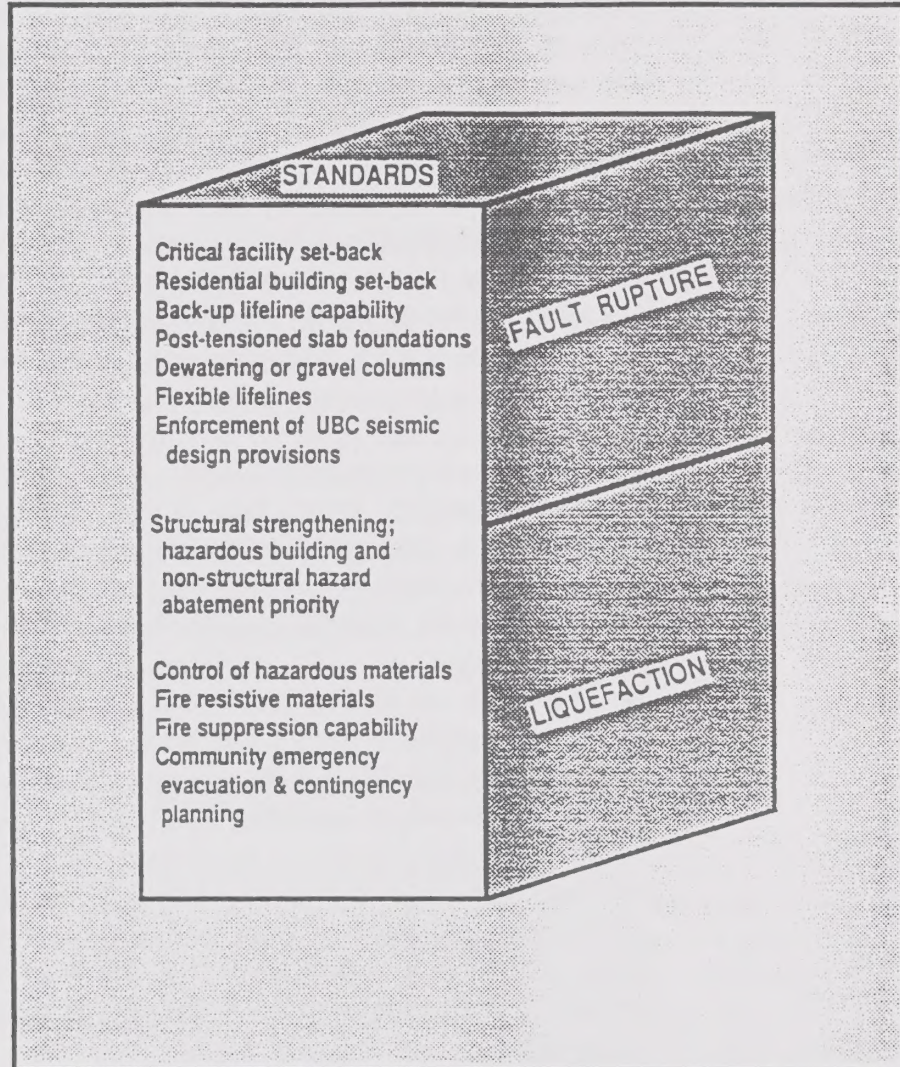
Safety provisions for fire or flood hazards, which in many cases are coincident with, or may compound, earthquake hazards, can be included into an overlay. This comprehensive approach can increase public awareness and promote overall safety. Figure 19 on the following page shows possible special development and hazard reduction standards for a hypothetical overlay zone delineating fault rupture and liquefaction hazards. A zoning overlay can also be applied to existing development, such as abatement of structural and nonstructural building hazards. Incorporation of density restrictions and/or requirements for fire resistive construction standards into project approval offers a proactive strategy to curb fire hazard concerns created by an increasingly dense urban development. Density limits and restrictions on types of sensitive land use (dependent care populations) might also be developed in dam inundation areas.

Subdivision review procedures can impose many of the hazard reduction measures listed in Figure 19 on new development. Seismic overlay hazard reduction standards are well suited to redevelopment. Hazard reduction actions could be handled with minimal impact through existing performance review programs. To operate retroactively for existing development, an abatement schedule and appropriate hazard mitigation plans would need to be developed. Under one option, the overlay could require structures to come into conformity within a specified amortization period. The length of the period would vary according to the scale of rehabilitation cost or the sensitivity of the building i.e., high-occupancy, dependent care population, etc. Under another plan, conformity could only be required if and when the nonconforming structures were proposed for substantial renovation.

3. BUILDING SAFETY - HAZARDOUS BUILDING ABATEMENT PROGRAMS

A hazardous building abatement ordinance aimed at pre-1934 unreinforced masonry (URM) buildings has been successfully implemented in the City of Burbank (see Section E.7., pages 84 to 86). Mandatory abatement programs provide the City with a tool to address structural and nonstructural seismic

SEISMIC HAZARDS OVERLAY



Special development standards that could be applied to a seismic hazards overlay zone in areas prone to fault rupture or liquefaction

Figure 19: Seismic Hazard Overlay/Hazard Reduction Measures

deficiencies in other known potentially hazardous buildings. A list of such building types is provided in Section E.7. on page 85. Retroactive fire safety provisions can also be incorporated into a hazardous building ordinance.

A hazardous building abatement program is well suited for Citywide application because it has a high potential for improving overall safety. Such a program can be tailored to employ rehabilitation, occupancy reduction, or seismic safety actions such as immobilizing gas-fired appliances and installing fire sprinkler systems. Varying amortization periods, using either voluntary or mandatory schemes, offer a series of alternatives for the wide range of building types and ages, and for the accompanying risks posed by hazardous structures.

As URM buildings are retrofitted or demolished as part of a seismic hazards reduction program, the state may eventually require other potentially hazardous non-URM buildings to be identified and abated.

A hazardous building inventory and structural screening program as well as a penalty system for noncompliance are important parts of any hazardous building abatement program. The City identified 51 pre-1934 URM buildings as part of its hazardous building abatement ordinance, but other building types may also pose a seismic hazard. Varying amortization periods for buildings of different risk represents one successful method that has been applied in some jurisdictions. Other jurisdictions have waived floor area restrictions on infilling if seismic retrofit action is undertaken for the existing structure. Deferring potential liability to building owners and carefully crafting penalties for noncompliance are other components of an effective program.

A hazardous building abatement program directed specifically at structures housing critical facilities is another option. Permit procedures and building regulations could be adopted which would apply to the various types of critical facilities. The requirements would vary according to the intended use of the facility, such that, for example, highest risk facilities (such as chemical processing plants) would require a more detailed investigation than a lifeline system facility.

4. HAZARD REDUCTION INCENTIVES PROGRAMS

Incentives offer a voluntary hazard reduction technique for existing development. Incentives provide the public sector with immediate or short-term rewards for long-range earthquake hazard mitigation and/or preparedness actions. Tax incentives, protection against owner legal liability (building owners who make no reasonable provisions to mitigate recognized seismic hazards may be made legally liable for damages to life if someone in the building is hurt during an earthquake), or public recognition for rehabilitation of potentially hazardous buildings are some examples of hazard reduction incentives that have been employed to encourage the abatement of potentially hazardous buildings. Granting expedient building permit processes for appropriate renovation or redevelopment is another alternative for promoting hazard reduction action.

A comprehensive hazardous building abatement program can be implemented to require voluntary or mandatory strengthening of high-risk structures, or to reduce the building's maximum occupancy to a level that coincides with the risk posed by the structure. Additional programs can be developed to promote seismic safety actions which reduce risk, like immobilizing gas-fired appliances, encouraging early warning gas shutoff systems in areas of liquefaction, strengthening residential foundation/frame components, etc. Incentive programs may be best applied as a component of a comprehensive safety program.

5. INFRASTRUCTURE/LIFELINE PROGRAMS

The risk of the community being exposed to gas, sewer waters, and other leaks can be reduced if policies and plans are implemented requiring major lifelines to be located away from known hazardous areas, such as liquefaction-prone areas and active faults, in new developments. A separate lifeline seismic safety policy could be instituted which would incorporate many of the provisions noted in Figure 19 on page 90. Such a policy can also be part of subdivision regulations. When feasible, this policy should be applied to existing lifeline systems through a retrofit, hazard reduction or relocation program. Such an action would reduce the risk of exposing the community to hazards, would ensure

effective emergency specifications, and would promote prompt restoration of normal services in the event of an earthquake.

Alternative locations for existing lifelines in hazardous areas are constrained by right-of-way routes, jurisdictional law or property ownership.

The ability to control lifeline decisions may be limited; local jurisdictions can only petition major independent service utilities to undertake a more comprehensive lifeline safety program. Negotiations for performance standards need to consider potential increases in ratepayer costs.

Hazard reduction measures must also address the retrofit of gas-fired appliances and pipeline connections in private residential properties, which also pose the risk of post-earthquake fire. Public education programs that address these issues should be considered. Figure 20 on page 95 suggests the retrofit and strengthening of lifeline infrastructure in certain seismic zones for particular types of development.

6. REAL ESTATE DISCLOSURE

The Alquist Priolo Special Studies Zone (APSSZ) Act requires California real estate agents and sellers to inform prospective home buyers if the property being sold is near the trace of an active fault rupture zone. California also requires the sellers of real estate to disclose any known defects including earthquake hazards. If the structure was built before 1960, the seller must give the buyers a copy of "The Homeowners Guide to Earthquake Safety", a booklet prepared by the Seismic Safety Commission which contains information on geologic and seismic hazards, an explanation of structural and non-structural earthquake hazards and recommendations for mitigation of identified hazards. Informing potential buyers during real estate transactions is intended as a tool to increase public awareness and as an incentive to promote risk avoidance action. Risk avoidance may include actions to safeguard household utilities, structural or nonstructural strengthening, or purchase of earthquake insurance. Inasmuch as an APSSZ has not yet been designated for the Verdugo Fault or other faults in Burbank, the City may consider providing a more effective and comprehensive local

disclosure process that would also include areas susceptible to liquefaction.

This type of disclosure would increase public awareness without increases in administrative costs; presumably the real estate board would monitor disclosure. The City could distribute information on voluntary hazard reduction alternatives for properties in these areas.

Local jurisdictions have only indirect control through delineating hazardous areas and requesting cooperation of real estate agents. Although real estate agents and sellers of property may oppose such action on the grounds that it may reduce resale options and increase the transaction costs, studies have shown that housing price trends are not affected by such real estate disclosures.

7. POST-EARTHQUAKE RECONSTRUCTION ORDINANCE

The purpose of a reconstruction ordinance or policy is to discourage inappropriate development from reoccurring in areas proven susceptible to high earthquake risks. Unacceptable earthquake risk may become evident in areas heavily damaged during an earthquake, depending on the nature and type of land use proposed for redevelopment.

Development regulations which have been prepared prior to a disaster, permit rational rebuilding decisions in the immediate aftermath of an earthquake disaster. If reconstruction of inappropriate facilities is allowed, the public may eventually absorb a large share of the repair costs and/or be exposed to excessive risks in future disasters. A balance must be achieved between the rights of property holders, and the local government's responsibility to minimize the high cost in economic losses or lives in areas exposed to extraordinary earthquake risks.

In 1995, the City Council adopted an ordinance which amended the Burbank Municipal Code to allow restoration of non-conforming buildings which were damaged or destroyed as a result of a local emergency or disaster. The amendment allows buildings which are non-conforming with regards to the existing City development standards, to be reconstructed

Figure 20: Selected Seismic Safety Hazards Reduction Programs

SELECTED SAFETY ELEMENT HAZARDS REDUCTION PROGRAMS

ZONES*	FUTURE DEVELOPMENT	EXISTING DEVELOPMENT	REDEVELOPMENT - RENOVATION	URBAN INFILLING
ZONE 1	A B C E F	C D E F	A B C D E	A B C E F
ZONE 2	A C E	C D E F	A B E F	A B E F
ZONE 3	A B	D	A B D	A B E
ZONE 4	A	D	A D	A E
ZONE 5	A C ¹	C ¹ D	A C ¹ D	A C ¹
ZONE 6	A C ² E G	C ² D G	A C ² E G	A C ²

Hazard Reduction Programs

- A. Stringent Enforcement of Building and Fire Codes Standards
- B. Special Project Requirements, Including:
 - Fault trenching and building setback (variable according to site-specific provisions)
 - Liquefaction Investigations (0-30 ft for conventional development; 0-50 ft for critical facilities)
 - Liquefaction mitigation (for buildings > 3 stories high, or with over 2000 lb/sq.ft of load)
- C. Special Hazard Reduction Measures
- D. Building Safety Abatement Programs (Including structural, nonstructural and fire hazards)
- E. Hazards Reduction Incentives (to be applied city-wide; priority implementation suggested in areas perceived as having a high seismic risk)
- F. Retrofit and Strengthening of Lifeline Infrastructure
- G. Disaster Response and Awareness (to be applied city-wide with priority in areas perceived as having a high seismic risk)

* Map Symbol / Zone Explanation (see Plate 1, In Pocket)

- Zone 1 - High risk of fault rupture and moderate to high susceptibility to liquefaction
- Zone 2 - Moderate risk of fault rupture
- Zone 3 - Moderate susceptibility to liquefaction
- Zone 4 - Low susceptibility to liquefaction
- Zone 5 - High susceptibility to rock-falls
- Zone 6 - Areas prone to dam inundation

Those programs shaded in the table apply to critical facilities only, all others apply to both conventional development and critical facilities.

1. The mitigation of natural and artificial cut slopes prone to rock-falls should be a high-priority in hillside areas. Plans for the expedient removal of rock debris to clear emergency routes should be developed.
2. Long-term reduction programs should encourage the siting of critical facilities, such as high-occupancy buildings, dependent care facilities and facilities using or storing hazardous materials in areas not prone to dam inundation. Increased urban density in dam inundation areas should also be discouraged.

with the same nonconformities as the original building in the event that they are damaged, destroyed or demolished as a result of a local emergency. The rebuilt properties are, however, required to meet all life safety codes and requirements including but not limited to current building and fire codes. Property owners wishing to replicate nonconforming buildings are subject to the administrative use permit (AUP) process, which includes public notification of the proposed permit, the opportunity for an administrative hearing before the Planning Board, and appeal rights to the City Council.

G. SEISMIC SAFETY POLICIES

The overriding City of Burbank goal with regard to seismic safety is to PREVENT LOSS OF LIFE, MAINTAIN THE FUNCTIONING OF CRITICAL FACILITIES AND MINIMIZE PROPERTY LOSS AND DAMAGE. The following policies are intended to achieve this goal.

- P1. Maintain close coordination between developers, consultants and responsible agencies to ensure that geotechnical investigations are conducted to evaluate the liquefaction potential of sites in identified liquefaction prone areas or the recency of movement of an identified fault. Appropriate risk factors for potentially active faults and faults with uncertain activity should be carefully considered.
 - The liquefaction potential of a site should be evaluated when, during the course of a geotechnical investigation, shallow groundwater (50 feet or less) and unconsolidated sandy alluvium soils are found.
 - Fault investigations in the Verdugo Fault zone should be encouraged where feasible. The responsible agency may describe the level of detail required in these investigations and the recommended building setback from the fault. The state geologist should be informed of any findings pertinent to the activity designation of the fault.
- P2. Continue to require geologic investigations in hillside areas with slopes greater than 25 percent. Rights-of-way and cut slopes should be designed and built so as to prevent

- P3. Continue to enforce seismic design provisions of the current Building Code. Seismic design parameters for conventional development and critical facilities should be recommended by the site design engineer and approved by the City. The design parameters should be based on the importance of the structure to the community. The more conservative estimates of earthquake recurrence and intensity of ground motion shall apply to the design of critical facilities.
- Continue to enforce dynamic analyses provisions of the current building code. Any proposals for critical facilities in the basin area of the City should require a site-specific investigation of the ground conditions to evaluate the potential of damaging site amplification occurring during an earthquake.
 - Continue to verify that new development complies with the Uniform Building Code (UBC) seismic design standards and the Burbank Municipal Code, by means of in-house expertise or consultation with a private structural engineer. Continue to verify that structural and architectural features, such as irregular building shapes, soft-stories, undefined structural systems, architectural elements, equipment attachments, etc., are designed in accordance with the seismic provisions of the Uniform Building Code and current professional structural engineering practices.
 - Hospitals, emergency facilities, high occupancy buildings and other types of critical facilities shall be designed to comply with the UBC seismic provisions.
- P4. Review the following types of critical facilities proposed for development or expansion to ensure that identified hazardous conditions are mitigated or hazard reduction features are incorporated to the satisfaction of the responsible agencies.
- Any lifeline system under the City's jurisdiction, such as power and water utilities, and roads that may serve as evacuation routes in an emergency.
 - Essential facilities needed in an emergency, such as hospitals, fire and police stations, emergency operation centers and communication centers.

- High-risk facilities that, if damaged during an earthquake, may have an impact on the community far beyond the facilities themselves. These include dams, airports and industrial plants that use or store hazardous materials.
- High-occupancy facilities such as high-rise buildings, large public or private assembly facilities and large multi-family residential complexes (with a capacity over 500 persons) which may be difficult to evacuate during an emergency, or which, if damaged as a result of an earthquake, can result in a large number of casualties.
- Dependent care facilities housing populations with special evacuation considerations, such as preschools and public and private schools, rehabilitation centers, prisons and major social care facilities, including group care homes and elderly homes.
- Economic facilities whose continued operation is paramount to avoid severe economic losses, such as banks, vital record keeping and archival facilities, computing and data processing centers, airports and railroad facilities, and large industrial and commercial facilities.

P5. Employ incentives whenever feasible to encourage the mitigation of existing hazardous structures and conditions. These incentives may include expedient building permits, waivers from development standards, public recognition or tax credits. Incentives should be considered in the following cases:

- To encourage the siting of critical facilities in areas that are not of high seismic risk (such as Zone 1 in Plate 1, in pocket);
- To retrofit structural and non-structural hazards in privately-owned potentially hazardous buildings, and to retrofit historical buildings to standards above those mandated by the State Historical Building Code;

- To incorporate into existing and proposed critical facilities such preventive measures as fire-resistant materials, self-contained fire suppression features (such as sprinkler systems or gravity water flow lines in mountainous areas), on-site evacuation and contingency plans, back-up lifeline capabilities, etc.;
 - To restrain gas-fire appliances and other non-structural elements that may pose a hazard if moved or tumbled during an earthquake.
- P6. Consider the inclusion of seismically high-risk buildings--such as those with masonry-infilled walls, soft stories, non-ductile concrete frames, tilt-up concrete construction, and woodframe cripple wall construction--in the City of Burbank seismic retrofit ordinance. This would require the identification of these buildings, followed by implementation of a mitigation program.
- P7. Encourage and facilitate the retrofitting of bridges and highway structures in the City of Burbank in coordination with the County of Los Angeles Department of Public Works and the California Department of Transportation.
- P8. Promote the maintenance and development of seismically resistant lifeline systems to ensure their continued function, to expedite post-earthquake repairs and to have emergency back-up capabilities. Emphasize the following:
- Promote the use and maintenance of back-up power generators in critical facilities such as group care homes, day care and other health care facilities, and in emergency and high risk facilities such as the Burbank-Glendale-Pasadena Airport, schools and other sites that are likely to be used as shelters; and
 - Advocate the continued review and mitigation, if necessary, of natural gas and petroleum pipelines, and other pipelines used to transport hazardous substances, especially if located in areas of high seismic risk.
- P9. Promote the development of community or neighborhood disaster relief groups, and workplace self-help groups, to improve the effectiveness of local emergency response, light search and rescue and emergency medical care teams. Existing associations such as homeowner groups,

neighborhood watch programs, or new organizations created for earthquake relief purposes can serve as auxiliary emergency response teams to aid the public and non-profit organizations responsible for such actions as first aid, shelter, traffic control, light search and rescue and utility shut-off.

- P10. Require a disclosure clause for any property transaction for a site located in an identified seismically hazardous area. The disclosure clause, provided by the Real Estate Commissioner, includes those hazards identified during the site investigation, and a verification of the hazard mitigation measures applied as a condition for project approval.
- P11. Consider development of a geographic information computer system (GIS) with computer-aided design and drafting (CADD) capability to streamline the process of reviewing projects and to manage safety information, such as the following:
- Existing and future geotechnical and seismic data contained in public, private and City archives, including the California Division of Mines and Geology, the Environmental Protection Agency, the Department of Water and Power, Lockheed, etc.
 - The locations and details of hazardous structures, critical lifelines and critical facilities. Data about these facilities should include the building's age, function, occupancy and structural risk.
 - A listing of disaster response plans and resources available so these can be implemented immediately in case of emergency.
 - An overlay of seismic constraints to assist in emergency response planning.
- P12. Formulate a post-earthquake reconstruction policy. The policy should include a provision requiring that rebuilt facilities, especially critical facilities, in the areas impacted the most by liquefaction or surface fault rupture, be designed to withstand those specific types of seismic activity. The post-earthquake reconstruction policy should also include provisions by which services provided by the Federal Emergency Management Agency, the State Office of Emergency Services, and other responsible agencies and local

jurisdictions are expediently coordinated to assist in the provision of housing for dislocated residents.

V. FIRE HAZARD

A. INTRODUCTION

Serious fires in the City of Burbank occur infrequently. However, there is always the potential for a fire which could threaten human life, property and the well being of the community and its citizens. The City of Burbank is susceptible to both wildland and urban structural fires; the Burbank Fire Department (BFD) firefighters are trained in both structural and wildland firefighting techniques.

B. FIRE HAZARD ANALYSIS

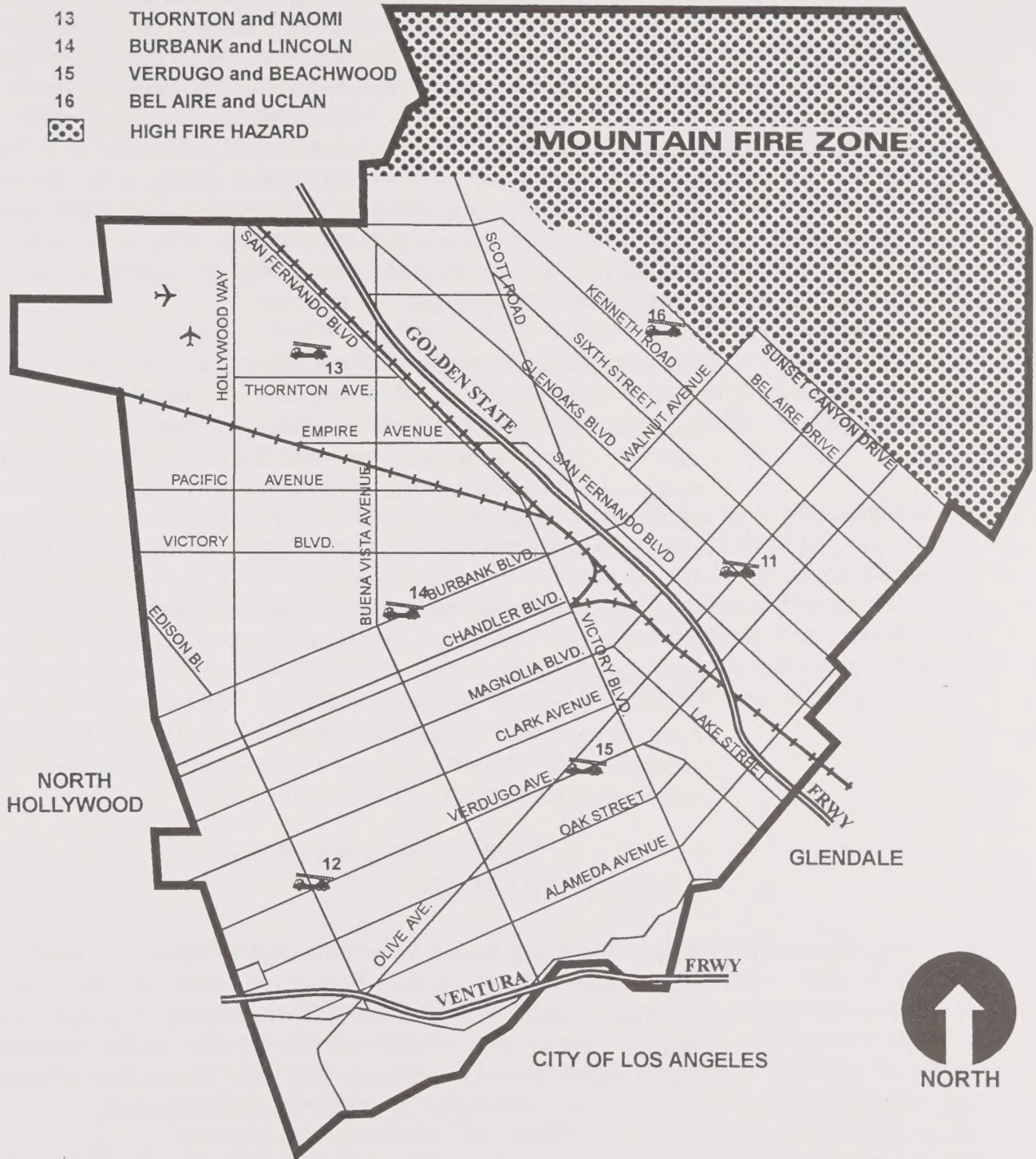
1. WILDLAND FIRES

Wildland fires refer to those fires which occur in undeveloped areas and have the potential to destroy vegetation, wildlife habitats, the watershed and structures. These fires usually originate outside of structures in the urban/wildland interface area, and are usually caused by human carelessness with matches, cigarettes or campfires. Wildland brushfires are extremely dangerous to firefighters because this type of blaze moves quickly--sometimes traveling as fast as 30 miles per hour or greater--and, depending on local weather conditions, can be very unpredictable.

Burbank's wildland includes the area above Sunset Canyon Drive, generally following the contour of the foot of the Verdugo Mountains (see Figure 21 on the following page). This area is designated as the Mountain Fire Zone (MFZ), and is characterized by mountainous hillsides, heavy vegetation and narrow streets. These conditions, combined with the local climate, exacerbate the potential for wildland fires to ignite and spread. The MFZ is comprised of 2,956 acres of both private and public land: 2,257 acres are undeveloped "mountain reserve" land belonging to the City of Burbank, 228 acres are developed public park land, and 471 acres are developed residential areas.

LEGEND

STATION	LOCATION
11	OLIVE and GLENOAKS
12	HOLLYWOOD WAY and VERDUGO
13	THORNTON and NAOMI
14	BURBANK and LINCOLN
15	VERDUGO and BEACHWOOD
16	BEL AIRE and UCLAN
	HIGH FIRE HAZARD



CITY OF BURBANK FIRE ZONES and FIRE STATIONS

Figure 21. Fire Zones and Fire Stations

Wildland fires usually begin in areas which are steep in slope and where there is limited or no access for firefighting apparatus. The potential of these wildland fires to sweep into the hillside and into residential foothill developments is always a major threat. Access determines the relative difficulty of delivering both apparatus and personnel to a fire. With containment as the key, those areas with limited accessibility have a correspondingly greater risk from wildland fire than do more accessible areas. Efforts to protect lives and property from wildland fires focus primarily on brush clearance around homes.

The probability of a wildland fire occurring in the MFZ is high. Spring rains increase the amount of vegetation which becomes dry and flammable during the hot, dry summer months. These fires can be separated into two distinct categories: those which threaten homes and those which do not. Both types of fires are of concern; however, a blaze which threatens homes and human life is of special concern.

Urban/wildland interface fires pose a great threat to the environment, property and human life. Under the right conditions, a fire can occur at any given time, usually giving residents very little notice to evacuate. Available fuel, moisture content and prevailing winds are three of the major factors which determine where and when brush fires will occur and the intensity of the blaze.

2. STRUCTURAL FIRES

There is no one area of the City that is especially prone to structural fires. Rather, structural fires in the City's developed areas can occur anywhere and be of a variety of types. Most urban fires are started by faulty electrical equipment, carelessness or arson, and occur most often in commercial buildings and single family residences.

The emergence of high-rise buildings in Burbank has added a new dimension to the problem of dealing with structural fires. The potential for injury, loss of life and damage to property is greater in high-rise fires than in other structural fires. This is due to the large distances that need to be covered within the large buildings; this is both more time consuming and requires more personnel and equipment.

Fires in the industrial sectors of the city pose different types of problems for the City's Fire Department. Industrial fires have the potential of creating a toxic hazard or hazardous materials incident. (Hazardous materials incidents are discussed in Section VIII on page 126). One of Burbank's major industries, The Warner Brothers Studios, has its own, private, on-site fire department. This fire department provides emergency first response in the event of a fire, hazardous material situation or other disaster on their premises. They also assist the BFD by providing back-up first aid. The Burbank-Glendale-Pasadena Airport also has its own on-site fire department which provides first response for all airport related fires and accidents on airport property and in adjacent areas. This fire department is discussed in greater detail in Section VII which deals with Airport Accident Hazard.

Utility lines, such as gas and electricity, have the potential for starting fires in the developed areas of the City. While the normal construction of utility lines provides a good degree of safety, gas lines can break and overhead power lines can come down in which case they become fire hazards. A variety of events can trigger utility started fires including accidents, construction errors, Santa Ana wind conditions and seismic activity.

C. FIRE HAZARD RESPONSE

Efforts at improving fire safety have traditionally been divided into two areas--fire prevention and fire suppression. The Insurance Services Office (ISO) rates city fire and water systems using both response and prevention as criteria. The BFD is rated as a Class 2 which can be equated to "very good". In order to maintain this high rating, Burbank's response and fire prevention procedures are periodically updated. The Burbank City Council adopted the most current version of the California State Uniform Fire Code as the official fire code for the City.

The City of Burbank has six fire stations distributed throughout the City. These stations are shown on the accompanying map (Figure 21 on page 103) and are listed by address below. In addition, Burbank has a Fire Training Center used both for training purposes and as an Emergency Operations Center in times of emergency.

Station 11 -- 353 East Olive Avenue
Station 12 -- 644 North Hollywood Way
Station 13 -- 2713 West Thornton Avenue
Station 14 -- 2305 West Burbank Boulevard
Station 15 -- 1420 West Verdugo Avenue
Station 16 -- 1600 North Bel Aire Drive
Fire Training Center -- 1845 North Ontario Street

The BFD is the authority having jurisdiction over all fires and life threatening incidents in the City; this means it has ultimate responsibility and liability for the suppression of all fires in the City of Burbank. Even where private companies have their own trained firefighting personnel and equipment who respond first to a fire emergency, the BFD takes over control of the scene. The only exception to this is on interstate and state highways, where the California Highway Patrol has ultimate responsibility. The BFD is involved in a tri-city interjurisdictional agreement with the fire departments of the Cities of Glendale and Pasadena. The three cities involved assist each other without having to later pay for the assistance received. The agreement allows for the removal of city boundaries when fire safety or threat to life is concerned. Should any one city have a serious fire threat or use up all of its resources, the other two cities will provide the necessary fire fighters and equipment to help manage the incident. Verdugo Dispatch is a joint dispatch center, located in Glendale, which handles all fire department responses in the Cities of Burbank, Glendale and Pasadena.

In addition to the tri-city agreement, Burbank has a reciprocal arrangement with the City of Los Angeles in which the BFD is the initial responder for fire and medical aid at the Equestrian Center and other specific locations adjacent Burbank in exchange for aerial assistance and additional fire suppression resources. This aerial assistance is in the form of a helicopter which is capable of carrying a 350-gallon water load. Helicopter water-drops have proven to be an effective method of both containing and extinguishing brush fires, especially in mountainous areas.

Since it is recognized that no community has resources sufficient to cope with any and all emergencies which could occur, there is in place a statewide system of mutual aid. Mutual aid requests are processed through the State Office of Emergency Services (OES). Under this system each jurisdiction relies first upon its own and/or neighboring jurisdiction's resources to deal with a disaster before calling for outside assistance.

A local disaster or large scale emergency may require the coordination of volunteers to assist in various roles. There are approximately 225 Community Disaster Volunteers (CDVs's) registered with the City's personnel office; each of these volunteers have pledged to assist in times of disaster. These volunteers are prepared to assist City personnel in damage location, medical care, provision of emergency shelter and emergency amateur radio services to augment communications with other rescue organizations such as the Red Cross. A valuable component of Burbank's volunteer network which assists the community during times of disaster is the Burbank Emergency Amateur Radio Service (BEARS). Their primary function is to augment communication throughout the City, especially during times of emergency.

The wildland areas which are most vulnerable to brush fires are also the areas most limited in terms of available water supply and pumping capacity. In addition to providing heavy construction equipment to aid in fire suppression, the City's Public Works Department has a vehicle which is capable of carrying 1,500 gallons of water to the site of a fire. Starlight Mesa, located adjacent to the Starlight Bowl in the center of the undeveloped wildland area, provides an unlimited water supply by means of hydrants located adjacent each of three concrete helipads for helicopters aiding in wildland fire suppression efforts.

In the event of a brushfire in the hillside area of Burbank, the **following streets are to be used exclusively for emergency vehicle access.** Any east-west street can be used for evacuation with the exception of:

- Elmwood Avenue from Glenoaks to Sunset Canyon
- Providencia Avenue from Glenoaks to Sunset Canyon
- Tujunga Avenue from Glenoaks to Sunset Canyon
- Harvard Road from Glenoaks to Sunset Canyon
- Walnut Avenue from Glenoaks to Sunset Canyon
- Cambridge Drive from Glenoaks to Bel Aire
- Lamer Street from Glenoaks to Keystone
- Irving Drive from Sixth to Kenneth

The streets designated for emergency vehicle access in the event of brushfire are shown in Figure 22 on the following page.

In the event of a brushfire in the hillside area of town the following streets are to be used exclusively for emergency vehicle access. Any east - west street can be used for evacuation with the exception of the streets illustrated below:

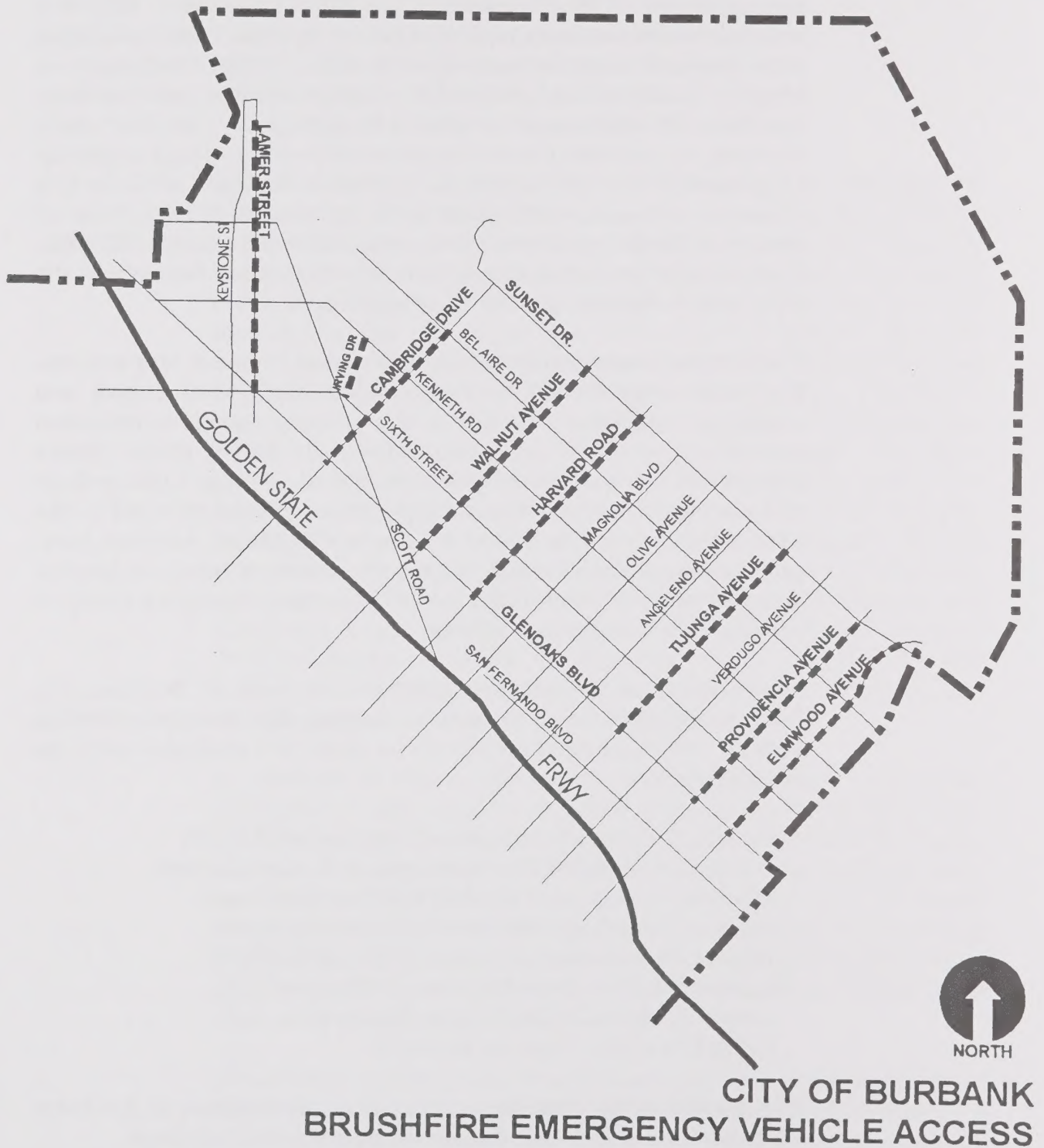


Figure 22. Brushfire Emergency Vehicle Access

D. FIRE HAZARD MITIGATION

Efforts to protect lives and property from wildland fires focus primarily on brush clearance around homes. The BFD requires hillside residents to remove native vegetation and mow all hazardous vegetation (grass and weeds) within 100 feet of any building or structure. The first 30 feet from the building must be cleared to ground level and the vegetation in the remaining 70 feet must be no more than 18 inches above the ground. The 18-inch height requirement is necessary to stabilize the soil to prevent erosion and mud-slides. Fire Station 16, at the base of the Verdugo Mountains, is responsible for management of the brush clearance program in the MFZ. In late spring, the BFD mails out an informational letter to affected property owners within the designated MFZ notifying them of the City's brush clearance policy and code requirements for private property. Property owners are given a reasonable amount of time to remove hazardous vegetation in compliance with Fire Code requirements before notices of violation are sent out. Most residents voluntarily comply with the City's requirements upon receiving the first letter. However, the City has, in the past, hired a contractor to remove hazardous vegetation on properties in which the owner has failed to comply. In such instances, the cost of correcting the hazard is added to the property owner's tax bill.

The City of Burbank contracts with Los Angeles County to remove brush on public land adjacent structures in the hillside area. In 1994-95, Burbank spent approximately \$60,000 for brush removal in the MFZ. Beginning in early July, Los Angeles County crews begin removal of hazardous vegetation from public land. The crews first cut priority areas identified by the BFD and citizen complaints.

The fire danger of wood shake and wood shingle roofs and exterior wall coverings has been well-documented. Flying brands which are carried aloft by thermal updrafts are of serious concern due to the threat of spot fires, especially in residential areas. "Spot fire" describes a fire which started by firebrands (burning material, leaves, wood, glowing charcoal or sparks) carried ahead of the main fire by wind. Spot fires pose a problem to firefighters because local resources become quickly overburdened. The Burbank City Council, in 1992, passed an ordinance which prohibits wood roof coverings and exterior wood shake wall coverings on any new or existing building or structure. This ordinance allows a 20-year amortization period for the eventual elimination of wood shingle roofs and exterior wall coverings in the City of Burbank.

The BFD has a multifaceted public education program, aimed at students, businesses, senior citizens, scouts and other clubs, and the City's residents at large. These programs are an important part of the BFD's efforts to prevent fire and other disasters in the community. The public education activities of the fire department include, but are not limited to, public school demonstrations, safety talks,, Disaster Preparedness Fair, Fire Prevention Week, Fire Services Day and utility bill informational inserts.

E. FIRE SAFETY POLICIES

The overriding City goal with regard to fire safety is TO REDUCE THREATS TO PUBLIC SAFETY AND PROTECT PROPERTY FROM WILDLAND AND STRUCTURAL FIRE HAZARDS. The following policies support the achievement of this goal.

- P1. Maintain and strengthen the review of projects and development proposals through vigilant enforcement of the adopted Fire and Building Codes, as well as the implementation of mitigation measures in areas of high wildland and structural fire hazard.
- P2. Continue to coordinate firefighting efforts with state and federal agencies as well as with neighboring local agencies.
- P3. Reduce fire hazards associated with older buildings, multi-story structures and fire hazardous industrial facilities.
- P4. Maintain an adequate fire suppression capability in areas of intensifying urban development.
- P5. Maintain and enhance fire prevention programs.

VI. STORM, FLOOD AND MUDSLIDE HAZARD

A. INTRODUCTION AND HAZARD ANALYSIS

Intense rain, or rain that lasts for several days, is the most common cause of floods and mudslides. Ideally, rain waters should be absorbed back into the earth. When there is more rain than can be absorbed by the earth, run-off is created; when run-off is excessive, flooding occurs. The rapid development of Burbank and the San Fernando Valley has placed an impervious cap of asphalt and structures over most of the orange groves and open fields that once absorbed much of the rainfall. As a result, the amount of run-off water which must be carried by streets, storm drains and flood control channels has increased substantially.

Burbank lies at the heart of the basin known as the Los Angeles County Drainage Area (LACDA), which consists of 1,460 square miles and over eight million people. Two main rivers, the Los Angeles and the San Gabriel, carry the water from this basin to the Pacific Ocean.

From the 1930s through the 1960s, the U.S. Army Corps of Engineers and the Los Angeles County Department of Public Works built the largest metropolitan flood control system in the nation, consisting of dams, channels and storm drains. Over the years, this system has collected flood waters, contained them in flood control channels and passed them out to the Pacific Ocean. As development in the metropolitan area continues, however, this system is increasingly becoming insufficient to handle the amount of run-off that used to be absorbed back into the ground. Since the early 1980s it has become evident that the existing flood control system is in need of significant upgrading in order to meet today's needs. The U.S. Army Corps of Engineers, in conjunction with the Los Angeles County Department of Public Works (LACDPW), has completed the Los Angeles County Drainage Area (LACDA) Study which identified several areas within the Los Angeles River incapable of conveying runoff from a 100-year storm. Flooding would be limited to just outside the channel confines along the City of Burbank's southernmost boundary line which parallels the Los Angeles River. LACDPW is further analyzing the limited flooding potential in this area prior to making final recommendations. Currently, construction of the LACDA Project is underway along the

lower Los Angeles River and certain tributaries to increase the level of flood protection in these areas.

Analysts and disaster planners describe floods of different sizes in terms of their statistically projected frequency: for example, 10-year, 50-year, 100-year and 500-year. A 10-year flood has a 10 percent chance of happening every year, a 50-year flood has a two percent chance and a 100-year flood has a one percent chance of occurring in any year. The map assigns zones based on the depth of anticipated flooding to the areas indicated as having a risk of flooding. The risk of large floods in any year is relatively small.

The LACDA flood control system does not have the capacity to prevent flooding from a 100-year flood which would cover about 100 square miles; serious flooding could result in some areas from storms above a 50-year size. A 100-year flood could affect many areas close to the Los Angeles River in the San Fernando Valley and downtown Los Angeles, including Burbank. A larger, though statistically less likely, 500-year flood would affect an even greater area of the LACDA.

Estimating the area subject to flooding from different size storms is not an exact science. Where water might break out of a channel depends on several factors, including where debris builds up to restrict or block further flow. Even once water breaks out of a channel it is difficult to predict where it will go with the accumulation of debris diverting the flow. Flood maps, then, are estimates based on the best data and analytical techniques available.

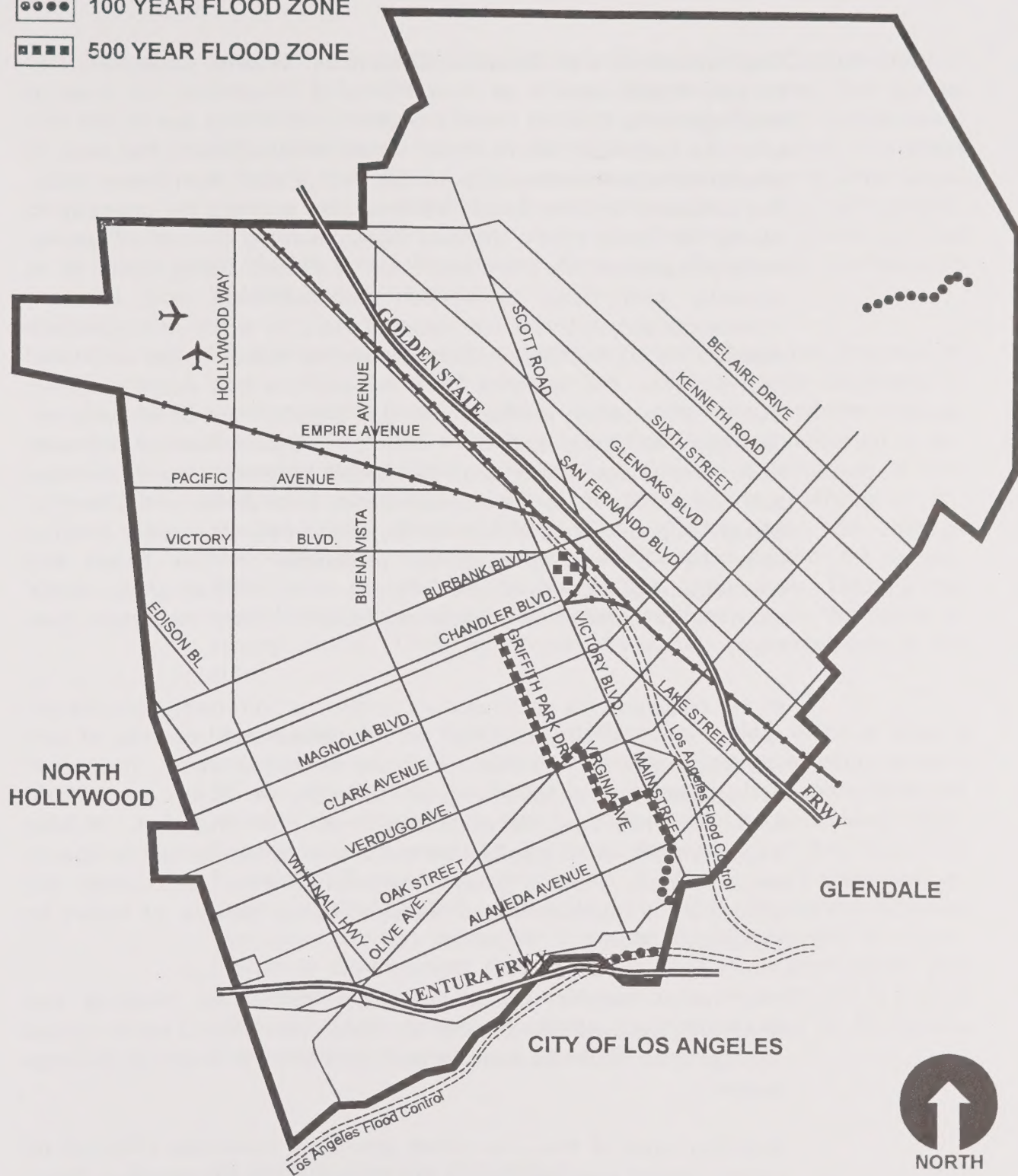
The Federal Emergency Management Agency (FEMA) administers the National Flood Insurance Program, which makes insurance available to individuals in communities with a flood hazard if the communities participate in the Federal Flood Insurance Program; Burbank is a participant in this program. FEMA has prepared flood insurance rate maps for the Los Angeles basin which identify areas lying within the 100-year and 500-year flood plains (see Figure 23 on page 113, and Plate 1 in the rear pocket).

The problems of flooding are different in the different topographic areas of Burbank. In the flat-land areas of Burbank, flooding occurs in streets, intersections and under underpasses. This occurs when the amount of run-off exceeds the capacity of the storm drains and when water accumulates in low lying areas.

LEGEND

100 YEAR FLOOD ZONE

500 YEAR FLOOD ZONE



CITY OF BURBANK 100 AND 500 YEAR FLOOD ZONES

Figure 23. 100 and 500 Year Flood Zones

The intersection of Burbank Boulevard, Victory Boulevard and Victory Place--known as Five Points--is commonly an area of flooding during times of heavy precipitation. This is due to the fact that the Lockheed Storm Drain, which runs adjacent this area, is unable to accommodate the run-off in this area from heavy rains. The Lockheed channel is only 12-feet wide and has the capacity to handle no more than a 10-year flood. During periods of exceptionally heavy rainfall, this storm drain and surrounding drains fill to capacity and flood residential neighborhoods and adjacent commercial properties. Other areas of the City which are especially susceptible to flooding include properties adjacent the Lockheed Storm Drain, the Burbank Channel and the Los Angeles River; Buena Vista Street in the flat-lands; Griffith Park Drive between Chandler Boulevard and Olive Avenue; Virginia Avenue between Olive Avenue and Oak Street; Oak Street between Virginia Avenue and Glenwood Place; the intersection of Lake Street and Chestnut Street; Empire Avenue in the vicinity of the airport; Lincoln Avenue near the I-5 Freeway; and the properties on Oak Street and Glenwood Place south of the City boundary. Not all of the above cited flood-prone areas appear on FEMA's Flood Insurance Rate Map.

In the hillsides, the problems are somewhat different, with heavy rainfall creating the potential for mudslides and torrents of rain washing out of the hills into the hillside residential areas. The threat of mudslides is especially great in years in which the hillside vegetation has been destroyed as a result of brushfire. Hillside vegetation serves to stabilize the soil and enables the soil to absorb more rainfall. Hillside grading and construction also create the potential for mudslides and erosion during periods of heavy or prolonged rainfall.

The major factors which contribute to hillside flooding and mudslides are brushfire burnout or inadequate ground cover, street configuration, drainage patterns and insufficient or blocked drainage basins.

Another area of the City which could be adversely affected by heavy rainfall and flooding is the City's Water Reclamation Plant. During heavy or prolonged rainfall, large quantities of water seep into the sewers through manholes and illegal drainage systems and can overload the treatment capacity of the wastewater treatment plant. If there is more sewage than can be treated it becomes necessary to either divert the excess sewage to the Los Angeles North Outfall or to dump untreated sewage into the Burbank Western Flood Control Channel adjacent the treatment facility. In

times of heavy rainfall the Burbank Western Flood Control Channel is very full with rushing water; this makes even the normal discharge of treated effluent into the channel difficult. In the event that untreated sewage must be released into the channel, the effect is less serious than during emergency releases during dryer times because the raw sewage is heavily diluted by the high rain waters. (A more detailed discussion of the possible impacts of emergencies on the Burbank Wastewater Treatment Facility can be found in Section IV.E.6. on page 81).

High winds which often accompany storms have the potential to create serious problems in the City. Strong winds can result in power outages caused by fallen trees or the effects of the wind on the electrical wires. Overhead electrical lines are designed to de-energize automatically if electrical flow is interrupted; if this automatic safeguard malfunctions, there is the likelihood of fire resulting from downed power lines. Falling trees can damage structures and vehicles and can inflict serious harm on people. Windblown objects are also a hazard of high winds. Roofing has been known to blow off and windows blow out as the result of strong winds. This can be very dangerous to pedestrians in the area.

In addition to the threat of flooding from rain, there is also a potential threat to the community of flooding as a result of dam failure; this type of flooding would, however, be a more localized flooding as compared to the citywide impact of flood level rains. Seismic activity would be the most likely cause of dam failure in Burbank. Burbank Reservoirs Nos. 1, 4 and 5 are classified as "dams" by the California Department of Water Resources because they have storage capacities in excess of 50 acre-feet of water. California Government Code requires that inundation maps and emergency response plans be prepared for dams or debris basins affected by state safety regulations. Inundation areas for Burbank's dams are shown on Plate 1 (in pocket).

B. FLOOD HAZARD RESPONSE

The City's Emergency Operations Center (EOC) is periodically activated because of flooding. In this event, the Public Works Department is the department designated as disaster manager. It is the Field Services Division of the Public Works Department that plays the key role in directing all flood control activities. After a

flood it is the Public Works Department that fills pot holes in the streets, repairs sidewalks undermined by the flood waters, clears debris Citywide, cleans out the City-owned debris basins, and removes debris and sandbags.

Burbank's Police Department is responsible for traffic control around cordoned off flooded areas and has primary responsibility for evacuation of residents. The Police Department assists the BFD and other agencies in the rescue of flood victims, as well as assisting the Field Services Division of the Public Works Department in managing flood-related incidents. The Police Department is responsible for evacuation. Due to the fact that some hillside streets act as drainage channels for the hillside area, the Police Department enforces parking restrictions in the hillside area during major storms to prevent vehicles from being washed down the street as has happened in earlier years.

The BFD is prepared to respond to all types of flood situations including flooded structures, street and intersection flooding, hillside flooding and mudslides. Individual engine and truck companies routinely carry equipment which is needed in the majority of storm-related calls; there are, however, certain situations in which specialized training and equipment is needed, such as swift water rescue. In the event of a flood control channel rescue, when there is a high volume of water accompanied by a swift current, the BFD immediately deploys its own swift water rescue personnel and receives assistance from neighboring jurisdictions through mutual aid agreements. The BFD is responsible for conducting search and rescue for mudslide victims.

The City's Multi-Hazard Disaster Plan details response actions and responsibilities for responding to a flood or mudslide emergency.

C. FLOOD HAZARD MITIGATION

The Public Works Department is responsible for the distribution of sandbags to residents of Burbank to mitigate the effects of flooding. In the fall, hillside residents receive pamphlets instructing them on how to use sandbags to divert water and mud flow. In years where there have been hillside brush fires, the Public Works Department plans for the anticipated rain season. The department consults with planning experts at the Los Angeles Flood Control District and requests the calculation of the amount of debris that can be

expected to move from the hillside. The calculations are based on affected acreage and the slope. The Los Angeles Flood Control District plots anticipated mud flows on maps and charts the approximate yardage of hillside that is expected to move. From this data, the City can plan for residential evacuation contingencies and schedule the maintenance of debris basins.

Hillside grading and construction increase the potential for mudslides. This hazard can be mitigated by requiring engineering geologic and soils reports prior to subdivision approval and/or the issuance of a grading permit. These reports are intended to identify and characterize the hazard, assess the risks posed by the proposed development and grading practices, and identify mitigation measures that reduce any such risks to an acceptable level. Following grading and construction, the City requires that hillsides be replanted with fire resistant vegetation, and provided with sprinklers to maintain the new vegetation.

D. FLOOD SAFETY POLICIES

The overriding goal of Burbank's flood control planning and programs is to MINIMIZE INJURY, LOSS OF LIFE AND PROPERTY, AND ECONOMIC AND SOCIAL DISRUPTION CAUSED BY FLOOD AND INUNDATION. The following policies are intended to achieve this goal.

- P1. Inform developers requesting development permits--especially for critical facilities--within the designated 100-year flood plain, of potential risks and require construction and hazard mitigation per the UBC and Burbank Municipal Code.
- P2. Inform property owners requesting development permits in the designated high-risk inundation areas of the potential risks and provide recommendations for hazard mitigation where possible.
- P3. Continue to participate in the Federal Flood Insurance Program to ensure that flood insurance will be available to individuals in the community.
- P4. Continue to maintain and upgrade where necessary those components of Burbank's flood control system that are under the City's jurisdiction, in order to ensure that the system is

capable of protecting existing and planned development in the City from the increasing amounts of run-off that result from continued urbanization.

- P5. Encourage and facilitate the upgrading of the county flood control systems to increase the capacity of the system.
- P6. Enforce regulations which prohibit the draining of rainwater into the sewer system.
- P7. Promote flood and storm danger awareness through public education.

VII. AIRPORT ACCIDENT HAZARD

A. INTRODUCTION AND HAZARD ANALYSIS

The Burbank-Glendale-Pasadena (BGP) Airport is the source of most air traffic in the City of Burbank. The airport is located in the northwestern corner of the City (see Figure 24 on page 121). The airport has been in operation since 1930, both as a private venture and as a public transportation facility. Lockheed bought the airport in 1940 and operated it until 1978 when the Burbank-Glendale-Pasadena Airport Authority--a joint powers authority--bought the facility. The Burbank-Glendale-Pasadena Airport Authority runs the airport and maintains a contract with Airport Group International, Inc., to provide daily operations and maintenance. The BGP Airport serves commercial airlines, as well as military aviation and general aviation needs. The following table shows the proportionate use of the airport facility by each type of aviation.

AIRCRAFT OPERATIONS 1995 AND 1996				
	AIR CARRIER	GENERAL AVIATION & AIR TAXI	MILITARY	TOTAL
1995	34.3%	65.5%	0.2%	100%
1996	32.0%	67.8%	0.2%	100%
PERCENT OF CHANGE	-2.3%	+ 2.3%	0	

In 1996 approximately 4.8 million passengers utilized the airport facility. It is forecasted that passengers served by the airport could more than double over the next 15 years with a forecasted 10 million passengers using the Burbank facility annually by the year 2010. There was an average of 85.5 commercial flights departing Burbank daily in 1996; this number is forecasted to reach 143 departures daily in the year 2010.

As of 1996 there have not been any catastrophic aircraft emergencies in Burbank or involving the BGP Airport. There is, however, always the potential for an aircraft disaster, and this

potential increases with the increasing number of flights entering and leaving from Burbank each year. An "aircraft emergency" is defined as any crash, accident, fire or other disaster involving aircraft or any potential mishap for which stand-by equipment has been alerted by the Burbank Air Traffic Control Tower. An airport disaster has the potential of affecting almost any area of the City of Burbank because virtually all the populated areas of the City are within the perimeter of building height limitations imposed by Part 77 of the Federal Aviation Regulations (shown as the Airport Approach Area in Figure 24 on the following page), as well as areas identified in the City's Airport Approach Map (Burbank Municipal Code Sec. 31-1305).

There is no way to predict the time, place or size of an aircraft emergency, but several possible scenarios have been identified for planning purposes. These scenarios include accidents within the confines of the airport, accidents within the Burbank City limits, accidents occurring partially within the City and partially in a neighboring jurisdiction, accidents involving military aircraft with or without explosives and accidents involving radioactive or other hazardous materials; scenarios are in place for both ground accidents and mid-air collisions.

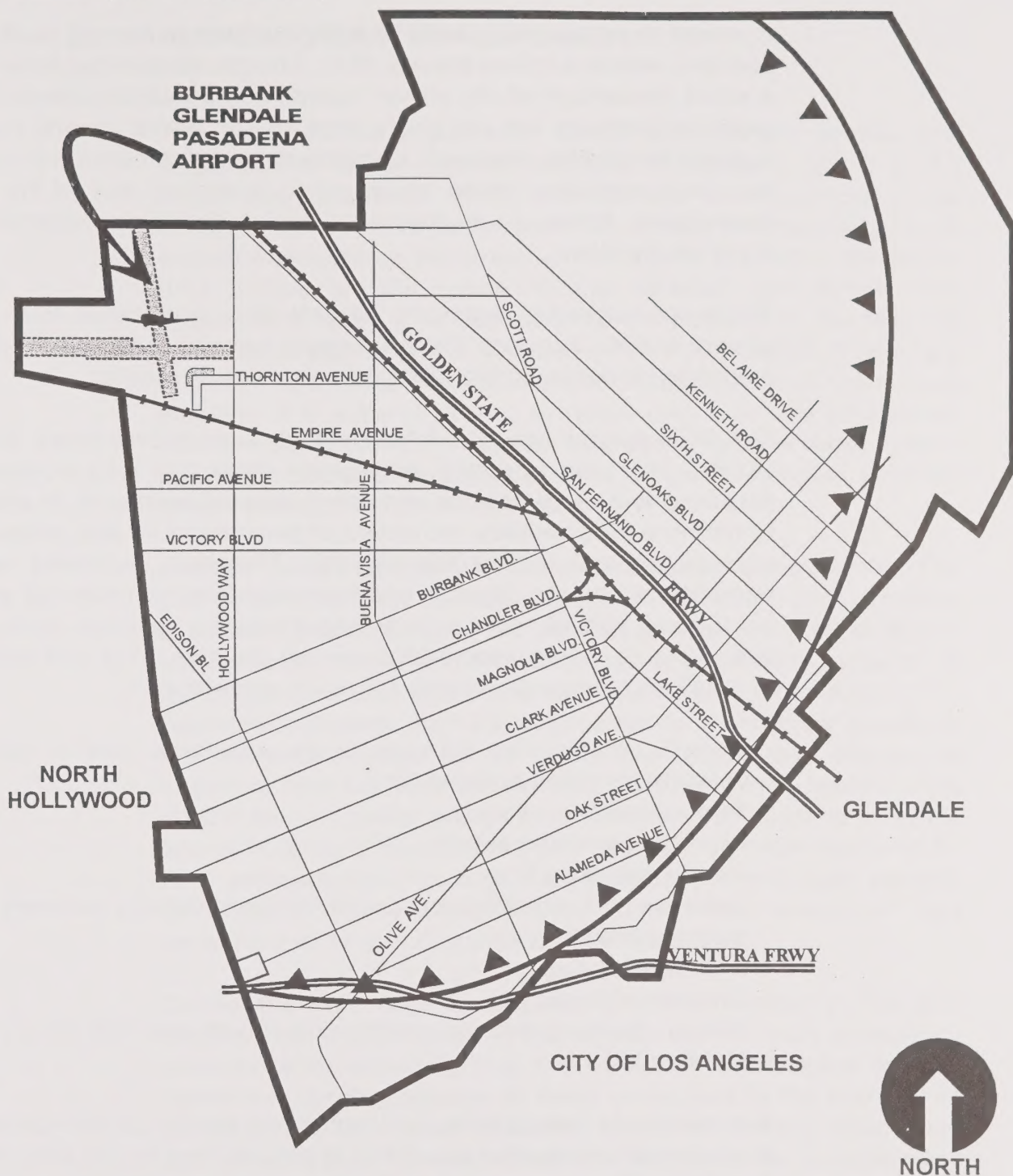
One of the more likely scenarios for an airport related disaster involves a commercial aircraft such as the Boeing 737, which is a widely used type of aircraft at the BGP Airport. This aircraft is used for short and medium distance routes and has a seating capacity of 145. The Boeing 737 has a wing span of approximately 95 feet and an overall length of approximately 110 feet; its total fuel capacity is 5,360 gallons.

If this type of aircraft were to crash in the developed urban area, it would affect many properties due to the speed and elevation at time of descent and the fuel load of the aircraft. The severity of the disaster depends to a large extent on the land use at the site of the crash--a high density residential area would result in more damage and danger to residents than, for example, a warehouse or industrial use. If a Boeing 737 were to crash in a medium density multiple family area, the area of the crash would be smaller than if the crash occurred in a lower density single family neighborhood because in the higher density areas the height and mass of the apartment buildings would slow the aircraft and absorb the impact. However, there would be more fatalities and injuries as well as more property damage than in a lower density area.

LEGEND



AIRPORT APPROACH & DEPARTURE AREA
(Within City of Burbank)



CITY OF BURBANK BURBANK-GLENDALE-PASADENA AIRPORT

Figure 24. Burbank-Glendale-Pasadena Airport

A worst case scenario would involve the largest aircraft used in Burbank, Airbus A310 or Boeing 757. Though accounting for only a small percentage of the airport operations, a mid-air collision or explosion involving this extremely large aircraft poses a worst case scenario for disaster planners. Currently these aircraft are only used by cargo operators which would result in limited loss of life to passengers, however, an increased probability for a hazardous materials incident.

There are numerous secondary hazards that could result from an airport-related disaster; these hazards include fires, hazardous materials incidents, traffic disruption and loss of utilities.

The BGP Airport has an FAA approved Airport Emergency Plan (AEP). This plan sets forth emergency plans that insure prompt response to all emergencies and other unusual conditions in order to minimize the possibility and extent of personal injury and property damage on and around the airport. The plan, approved and administered by the Director of Airport Services, is reviewed and coordinated with all agencies providing emergency services, tenants and all others having responsibilities under the plan. The AEP deals in detail with responses to the following emergencies.

- Aircraft emergencies such as crash, accidents, fire or other casualty involving and aircraft
- Bomb aboard an aircraft
- Bomb threat at the airport
- Airport structure fires
- Explosive and radioactive materials--the handling and recovery of such materials
- Aircraft hijacking
- Civil disturbance
- Natural disasters such as earthquakes, floods and high winds
- Lighting failure

It is recognized that all emergency situations cannot be anticipated; if an emergency situation arises that is not covered by the plan, the Executive Director or his/her designated representative has the authority to modify the plan, except as such modifications may contravene FAA regulations. Copies of the AEP have been distributed to and coordinated with the FAA, airport tower, firefighting and rescue agencies, including the Airport Fire Department, law enforcement, hospital emergency dispatch and principal airport tenants.

B. AIRPORT DISASTER RESPONSE

The Burbank Fire Department (BFD) has ultimate liability and responsibility for all disaster response in Burbank, but it is the Airport Fire Department which responds first to emergencies at the airport; the Airport Fire Department has primary responsibility for all aircraft emergencies occurring on the airport property. When the BFD arrives on the scene of the disaster, the Airport Fire Department hands over command of the incident to the BFD but continues to play an active supporting role. Although it is accurate to state that the Incident Commander retains control of the aircraft incident, it is imperative that all responding agencies understand that the overall control of airport operations, except those associated with the emergency incident in progress, remains with the airport management and operations staff.

The BGP Airport has its own crash/fire/rescue services on site. The BGP Airport Authority has contracted with an independent company to provide these services. In addition to responding to all airport emergencies, the Airport Fire Department continually inspects all buildings, sprinklers and hydrants at the airport. The Airport Fire Department exceeds the FAA requirement for emergency personnel and equipment stationed on site at the airport; this allows the airport to help out with certain local disasters when needed. The airport fire and police are on the "Disaster Net" system, which is one of Burbank's Emergency Operations Center radio frequencies. After emergencies at the airport are taken care of and under control, the airport makes available fire department manpower and equipment to help in Citywide disaster response.

During the Northridge Earthquake in 1994, service at the BGP Airport was uninterrupted. The airport has its own emergency generators for airfield lighting, control tower and terminal building operations; barring damage to these generators in the event of an earthquake or fire, they can keep the airport functioning, even when City power is out. The airport has its own manpower to assess and respond to airport damage--it does not draw on City manpower in times of crisis and doesn't need to wait for City manpower to be available. As evidenced in the 1994 earthquake, the airport can be a major community resource in times of disaster, receiving emergency airlifts, receiving incoming National Guard forces and serving as a staging area for troops during times of civil unrest.

The Airport Fire Department works closely with the BFD. The interface between the airport and BFD takes place through the

Verdugo Dispatch, which is a joint dispatch center located in Glendale for handling all fire-related emergency calls in Burbank, Glendale and Pasadena.

Four entities are involved in all potential and actual airport related emergencies, these are: Airport Fire Department, Burbank Fire Department, Airport Tower and Airport Operations. These entities work together to prepare for incoming emergencies when there is forewarning as well as in responding to an unexpected emergency.

Detailed emergency procedures for responding to an aircraft accident in Burbank can be found in the City's Multi-Hazard Disaster Plan.

C. AIRPORT HAZARD MITIGATION

Mitigation measures for airport related disasters fall into two categories: those designed to prevent airport related disaster and those aimed at creating a response system to minimize loss of life and property.

While the risk of aircraft-related disasters occurring in and around the airport cannot be completely eliminated, the City and Airport Authority can take measures to reduce that risk. Maintaining compliance with federal, state and local regulations and procedures helps ensure that the latest relevant safety standards are enforced at the airport. Such regulations include land use regulations designed to ensure that appropriate land uses, densities and building heights are located in the airport approach area and clear zones. Various measures to bring the airport into better compliance with FAA regulations that set a minimum distance between runways and passenger terminals are currently under consideration. The risk of aircraft-related disasters can also be reduced through ongoing careful maintenance of all airport facilities and aircraft leaving the BGP Airport.

In the event of an airport-related disaster, the effectiveness of the response can be the determining factor in mitigating loss of life and property. It is important, therefore, that there be effective communication and coordination between all responsible entities. This can be accomplished through ongoing interdepartmental training both at the airport and between the airport and the BFD. The City of Burbank Disaster Council Training program is one way

of achieving this important communication and coordination

D. AIRPORT SAFETY POLICIES

The overriding goal of this Safety Element regarding safety at the Burbank-Glendale-Pasadena Airport is TO REDUCE THE THREAT TO PUBLIC SAFETY AND PROTECT LIVES AND PROPERTY FROM LOSS AS THE RESULT OF AN AIRPORT RELATED DISASTER. The following policies are intended to further this goal.

- P1. Carry out and enforce proper land use planning around the BGP Airport to ensure land uses, densities and building heights compatible with the airport safety needs.
- P2. Comply with federal, state and local regulations and procedures which are designed to ensure the safe operation of the BGP Airport and the safe location of airport facilities.
- P3. Continually review and update when necessary the City procedures for responding to airport and aircraft-related emergencies.
- P4. Encourage and facilitate the continued coordination between the BFD and the Airport Fire Department in planning disaster response in the case of an airport-related disaster.

VIII. HAZARDOUS MATERIAL INCIDENT

A. INTRODUCTION

A hazardous material is any quantity of a substance which poses a threat to life, health or property. This includes a wide variety of solids, liquids and gases, all of which could be classified as hazardous. Thousands of new hazardous chemicals have been developed in this country since 1945 and more are being developed every day.

There is growing emphasis at all levels of government about protecting the environment for future generations and correcting existing environmental problems. With the proliferation of toxic chemicals, and processes which make use of these chemicals, more and more attention is being paid to the health hazards posed by these chemicals especially in or adjacent urban areas. In the second half of the 1980s, numerous state regulations for dealing with hazardous materials were put into place. These regulations are continually being updated and augmented. The Governor's Office of Emergency Services (OES) develops regulations for the reporting, monitoring and dealing with hazardous materials. According to state law, all businesses that handle specific quantities of hazardous chemicals must provide an annual inventory to the BFD and must develop, biannually, Business Plans for an emergency response to an accidental chemical release. As first responders to a hazardous material incident with the City of Burbank, the BFD has been designated as the administrative agency for collecting the mandated disclosure information.

B. HAZARD ANALYSIS

Hazardous materials, and especially their use in urbanized areas, have been identified as an increasing problem over the past several years. There is a definite risk of an accident involving toxic or hazardous materials occurring in the City of Burbank. There are several possible sources for such a hazardous materials incident in Burbank, including the transportation of hazardous or toxic chemicals through the City, the airport, industries and fixed facilities

that use or produce hazardous chemicals, underground pipelines and clandestine dumping. Each of these sources is discussed below.

1. Transportation-Related Hazards

The greatest toxic chemical risk to the City involves a hazardous materials accident on the roads and railways passing through Burbank or at the airport. The BFD and other City officials are not always made aware of potentially hazardous materials that pass into or through the City. Written notification is given only in specific instances required by the Department of Transportation, such as the transport of large quantities of certain toxic substances and hazardous wastes, or by the Department of Defense. These notifications are infrequent, and it is likely that significant quantities of hazardous materials enter the City without any notification at all. Transportation-related hazardous materials incidents can range from a chlorine spill resulting from an overturned pool maintenance vehicle to a derailed train car or tank car hauling toxic waste products or to an aircraft incident in the air that may release toxic cargo.

a. Streets and Highways

There is the possibility that a major hazardous materials incident will occur as the result of an accident on one of the highways or streets in the City. Highway 134 and Interstate 5 both cross through the City of Burbank. Both routes carry commercial vehicles that transport hazardous materials such as petroleum products, industrial wastes and toxic gases. An accident of this type could close the freeway for several hours requiring traffic to detour through Burbank streets. In the event of an accident involving a vehicle carrying toxic gas, such as chlorine, populated areas adjacent the highway would have to be evacuated.

b. Rail

There are three rail lines that traverse the City of Burbank: two lines run through the northwestern portion of the City and merge at the intersection of

Victory and Burbank boulevards continuing southeasterly into Glendale, the third line follows the length of Chandler Boulevard from the North Hollywood border northeasterly to merge with the line going into Glendale. The two lines running through the northwestern sector of the City carry both passengers and freight trains; the Chandler Boulevard line carries primarily lumber and wood products to lumber yards along the line.

The likelihood of a hazardous materials incident occurring as the result of a railroad mishap is less than that of an incident on the highways, yet the severity would be much greater because of the number of rail tanker cars that could be involved, the large quantities of toxic material contained in each car, and the potential for chemicals and explosive substances mixing. Since the Interstate 5 highway parallels and intersects the rail lines in various locations, it is possible that a hazardous materials incident on either mode of transportation could impact the other.

2. Airport

A hazardous materials incident involving an aircraft is the least probable of all transportation related incidents. An aircraft-related incident could involve an aircraft shipping hazardous material or an aircraft fuel spill. A hazardous materials incident occurring on the Airport premises is first responded to by the Airport Fire Department which has the necessary equipment and trained personnel to contain the incident. Command is then transferred to the BFD upon their arrival. Should the incident occur outside the boundaries of the airport, the Airport Fire Department could assist the City of Burbank HazMat Unit and other BFD units.

3. Fixed Facility/Industry

Burbank has several facilities, both private and City-owned, which manufacture, warehouse and/or process toxic chemicals and/or which generate hazardous waste materials. An accidental spill or other type of hazardous materials incident at one of these facilities is the second most likely scenario threatening the City, second only to a transportation-related

incident.

State law requires all businesses that handle specific quantities of hazardous materials to provide an annual inventory to the BFD as well as develop, biannually, business plans for responding to a hazardous materials incident. Over 600 businesses in Burbank handle toxic materials in amounts which require them to provide inventories and emergency plans to the BFD. These facilities are located in both commercial and industrial zones.

City-owned facilities which house substantial amounts of a hazardous material are:

- City of Burbank Public Service Yard
- City of Burbank Public Service Department Valley Pump Station
- City of Burbank Water Reclamation Plant

Each of these facilities has large amounts of chlorine on site.

4. Pipelines

There are several large underground pipelines in the City which, if broken, would result in major hazardous materials incidents: two are petroleum pipelines and the others are natural gas pipelines (see Figure 6 on page 28). These pipelines cross the Verdugo Fault Zone.

The Four Corners Pipeline Co. has a 14-inch petroleum product line which runs from north to south following Glenoaks Boulevard to Tulare Avenue turning southward on Sixth Street into the City of Glendale.

Pacific Pipeline System, Inc. (PPSI) has received approval from the California Public Utilities Commission to develop a 132-mile crude oil pipeline which will be used to transport oil produced in the San Joaquin Valley and offshore Santa Barbara County to Los Angeles area refineries. This 20-inch pipeline if built as proposed would cross through the City of Burbank along the Southern Pacific Railroad right-of-way, entering the City at Hollywood Way in the north and following the tracks along San Fernando Boulevard to the Glendale border (see Figure 6). Once the new pipeline is constructed, it is likely that the amount of crude oil currently

transported through Burbank via other modes will be reduced; the pipeline could replace the surface transport of crude oil by train, marine tanker and trucks, thereby reducing the risks associated with these modes of transport.

Hazards associated with this pipeline relate to potential crude oil spills, fires at the pump stations and/or along the pipeline right-of-way. The hazards associated with potential oil spills, and subsequent fires and impacts on resources, will be reduced by measures that PPSI will incorporate into the pipeline's design relating to oil spill prevention and response. An Oil Spill Contingency Plan for the pipeline must be reviewed and approved by the California Public Utilities Commission (CPUC) and local response agencies prior to the start of pipeline operation.

A 30-inch Southern California Gas Company natural gas pipeline follows Glenoaks Boulevard southeasterly into the City of Glendale. Other, somewhat smaller, high pressure natural gas pipelines follow Hollywood Way, Verdugo Avenue and Burbank Boulevard. Portions of these pipelines are adjacent the largest concentrations of industrially zoned land in the City, and parallel the Interstate 5 Freeway and the Southern Pacific Railroad lines.

A ruptured petroleum products pipeline could result in several hazards including soil and groundwater contamination, property damage, traffic congestion and health hazards; areas around the spill could have to be evacuated. A ruptured natural gas pipeline poses a serious danger from explosion and fire, threatening lives, property and disrupting traffic; evacuation in the area of a natural gas pipeline explosion may be necessary.

5. Clandestine Dumping

Clandestine dumping is the criminal act of disposing of toxic materials and hazardous waste products on public or private property. As the costs and restrictions increase for legitimate hazardous waste disposal sites, it can be anticipated that illegal dumping of hazardous materials will increase.

The large unpopulated industrial areas of Burbank and the numerous acres of remote undeveloped hillside in Burbank provide ample opportunity for illicit dumping of toxic

materials. This poses a threat to humans and animals who unwittingly come in contact with the toxic materials, and can leach into soils and groundwater creating a serious environmental hazard.

6. Asbestos

Asbestos is a naturally occurring mineral fiber that has been used extensively in construction and many other industries. Nearly every building contains asbestos in some form. It has been widely used because of its special properties; asbestos is very resistant to destruction by heat or chemicals and its fibers are extremely durable. These characteristics led to its wide use in wall insulation, paint, surfacing materials, ceiling and flooring materials, cement filler and a variety of other products.

Asbestos has been shown to cause cancer of the lungs and stomach when inhaled or ingested. In order for asbestos to be a health risk, asbestos fibers must be released from the material and be present in the air for people to breathe. Studies have shown that the mere presence of asbestos-containing material in homes and buildings does not result in increased exposure of occupants. However, disturbing or removing asbestos-containing products--such as during construction and remodeling--can result in release of asbestos fibers into the air, posing a serious health risk.

Federal, state and regional agencies are concerned with various aspects of asbestos as a hazardous material. These agencies regulate the removal and disposal of asbestos-containing products. The federal Environmental Protection Agency (EPA) deems any exposure to asbestos fibers to be a health risk and requires that any work dealing with asbestos be done by trained personnel. Effective January 1, 1990, the South Coast Air Quality Management District (SCAQMD) is primarily concerned with asbestos removal and emissions into the air. The SCAQMD Rule 1403 strengthened current federal asbestos regulations. Failure to comply with the provisions of this rule can result in a penalty of up to \$25,000. Rule 1403 mandates how building owners or their contractors are to report, remove, handle, label, store and dispose of asbestos containing materials. The California Contractors State License Board licenses and regulates all contractors who are qualified to do asbestos work in

buildings. The California Division of Occupational Safety and Health (Cal/OSHA) is primarily concerned with methods of removal and focuses on employee training and exposure. Cal/OSHA registers all contractors who perform asbestos abatement work and tests and certifies all asbestos abatement consultants.

Building owners or operators are responsible for making sure that

- The contractor is certified to handle asbestos (California State Contractors license certification and Cal/OSHA registration;
- The contractor notifies the SCAQMD in writing at least ten days prior to beginning any work involving asbestos;
- The contractor follows the SCAQMD requirements on how to analyze, handle, remove, label, store and dispose of any asbestos-containing materials; and
- All supervisors and workers involved in asbestos removal have had EPA-approved training courses in handling asbestos.

All construction, rehabilitation or remodeling taking place within the City of Burbank is subject to approval and licensing from the City Building and Safety Division.

7. Household Hazardous Waste

Household hazardous waste (HHW) is any discarded material that may threaten human health or the environment if disposed of improperly. Since 1989, the City of Burbank's program for collecting hazardous wastes used in the home has operated in conjunction with the Los Angeles County Household Hazardous Wastes Collection Program. This program includes numerous collection events that are held at various locations throughout the county and are open to all county residents. The City of Burbank has had a waste oil recycling program since 1983. The Burbank Recycle Center has a state-of-the-art waste oil collection center built with a grant from the California Integrated Waste Management Board. The waste oil center also includes areas to recycle anti-freeze and oil filters. In addition, a load-checking program, in which trash trucks are stop checked for hazardous materials, has been in place at the Burbank landfill since 1988. These programs are supported by an ongoing

public education program which includes the Burbank Recycle Center's clearinghouse of information. This information service helps citizens keep hazardous waste out of the ground water and the landfill and find substitutes for hazardous materials.

C. HAZARDOUS MATERIALS INCIDENT RESPONSE

The BFD is responsible for responding to all hazardous materials incidents in the City. The BFD has personnel trained as hazardous materials technicians assigned to fire stations throughout the City as well as a special HazMat Unit (HazMat 14) located at Station 14 (2305 West Burbank Boulevard). Information regarding the commercial and industrial businesses in the City, including site plans, existing inventory and location of hazardous materials at the site, and hazardous materials plans, is kept at HazMat 14. Hazardous material technicians are trained to respond to hazardous materials incidents with methods of containment and stabilization. Hazardous materials clean-up is performed under private contract and the cost borne by the property owner.

The Burbank HazMat Unit vehicle is equipped to be used to assist or manage hazardous material incidents. This unit shares staffing with an engine company at Fire Station 14. The HazMat Unit has the capabilities to:

- Control flammable and combustible spills and fires;
- Identify chemicals using analytical equipment, and test samples of unknown chemicals to determine specific properties, degree of toxicity, type of hazard, etc.;
- Use fully-encapsulated chemical suits with self-contained breathing apparatus to enter the hazardous zone;
- Decontaminate exposed personnel, equipment, apparatus and clothing;
- Use combustible gas indicators for determining the presence of explosive vapor gas clouds; and
- Contain spills by utilizing plugs, patches, diking materials, absorbents and other specialized equipment for the control of hazardous materials.

The HazMat Vehicle has an on-board computerized database with the location and properties of hazardous materials stored in the City.

Verdugo Dispatch in Glendale coordinates the response to all calls for hazardous materials assistance in the Cities of Burbank, Glendale and Pasadena. Burbank and Glendale each have their own hazardous materials units. It is standard practice to request the assistance of the City of Glendale's HazMat Unit on any working hazardous materials incident. This assures complete containment of the incident and an adequate level of staffing. The increased level of staffing heightens the level of safety for fire personnel if a unique containment problem should arise.

The Hazardous Materials Response Team will assist the Fire Department Incident Command throughout any emergency until the product is no longer a threat to life, health and/or the environment. Once the incident has been mitigated, it is up to the responsible party to clean the spill or assure that a qualified licensed contractor clean the spill and properly dispose of the hazardous product. Prior to the BFD's having a fully-staffed HazMat Unit, small acid and fuel spills took several hours to abate. Now, these same incidents can be handled in significantly less time.

The Los Angeles County Fire Department has three Hazardous Response Vehicles which are available upon request to any city in the county.

D. HAZARDOUS MATERIALS INCIDENT MITIGATION

There are numerous federal and state mandates, as well as local codes, that relate to the control of hazardous substances. Among such mandates is the State Hazardous Materials Release Response Plans and Inventory Program, otherwise known as Chapter 6.95 of the California Health and Safety Code. Burbank has adopted into the City's Municipal Code Chapter 6.95 of the Health and Safety Code dealing with the control of hazardous materials. Under this adoption the City Council has designated the BFD as the administering agency for these programs. In addition to the state-mandated programs, the BFD is responsible for enforcing Article 80 of the Uniform Fire Code, which deals with hazardous materials.

The City of Burbank operates several programs designed to reduce the potential of a hazardous materials accident occurring in the City and, in the event one does occur, to reduce its impact and damage. The City operates a Hazardous Materials Inventory Disclosure Program and a Risk Management and Prevention Program (RMPP).

The Hazardous Materials Inventory Disclosure Program identifies the quantity and type and storage location of hazardous materials in the community. The Risk Management and Prevention Program (RMPP) is intended to manage risk by preventing spills and releases of extremely dangerous materials or at least minimizing the adverse impact such a release may create.

Under the Hazardous Materials Disclosure Ordinance (BMC Section 15-1-8001.3.3) every business in the City of Burbank is required to submit a complete hazardous materials inventory disclosure report on an approved form to the BFD. If the business handles specific quantities of hazardous materials, it may be required to develop and implement a business emergency response plan. If the business handles acutely hazardous materials (AHM) above a specified quantity, then the BFD may require the business to complete an RMPP.

The RMPP includes several elements. The main supporting technical documents include a Hazard and Operability Study, a Seismic Assessment, and an Off-Site Consequence Analysis. The seven basic elements contained in a RMPP including the recommended corrective actions are to be based upon these supporting technical documents. The business has up to 12 months to complete the development of the RMPP and another 12 months to implement the recommendations of the RMPP once it has been approved by the BFD. Extensions may be granted by the BFD if necessary.

Recent amendments by the California legislature will change the way administering agencies do business. Senate Bill 1082 sponsored by Senator Calderon calls for the consolidation of six hazardous materials regulatory programs by January of 1996. The county is responsible for coordinating the consolidation effort which involves numerous local government departments, the county and state agencies. The programs being consolidated include the following.

1. Hazardous Waste Generator Programs, including tiered permitting inspections.
2. Above Ground Tank Programs Spill Control and Countermeasure Plan.
3. Underground Storage Tank Program.
4. Release Response Plans, Inventories, Business and Area Plans also known as Disclosure Programs.
5. Acutely Hazardous Materials/Risk Management and Prevention Programs.

6. Uniform Fire Code, Article 8001.3.2, Hazardous Materials Inventory Statement (HMIS) and Hazardous Materials Management Plan (HMMP) requirements and Burbank Municipal Code 15-1-8001.3.3.

In addition to this consolidation effort, amendments to the Federal Clean Air Act, call for implementation of an Accidental Release Prevention Risk Management Program (Fed-RMP) that is similar to the RMPP. This federal program delegates the responsibility for enforcement to the states. The states are likely to turn responsibility over to the local government. The federal government may permit agencies implementing the RMPP in California to be designated to administer the Federal RMP. If this comes about, the BFD would be burdened with another regulatory program to administer.

E. HAZARDOUS MATERIALS POLICIES

The overriding goal of the City is TO REDUCE THE THREATS TO THE PUBLIC HEALTH AND SAFETY FROM HAZARDOUS MATERIALS. The following policies are intended to implement this goal.

- P1. Review proposed developments involving the use or storage of hazardous materials, and disapprove proposals which cannot properly mitigate unacceptable threats to public health and safety to the satisfaction of responsible agencies.
- P2. Encourage businesses and organizations which store and use hazardous materials to improve planning and management of their on-site hazardous materials management procedures.
- P3. Promote efforts to reduce or eliminate the use of hazardous materials through dissemination of information and creation of incentives and disincentives.
- P4. Maintain a hazardous materials response capability that will adequately handle Burbank's hazardous materials safety needs.
- P5. Effectively coordinate all hazardous materials regulations with appropriate agencies.

- P6. Provide the residents of Burbank with information on the proper storage and disposal of hazardous materials and encourage the use of City disposal facilities and services.
- P7. Maintain City land use patterns which separate residential areas from commercial and industrial areas which allow the storage and use of hazardous materials.
- P8. Include information on soil contamination and storage of hazardous materials in the City's Geographical Information System (GIS); this information would be made available to the public and would be used when reviewing development proposals.

IX. CIVIL DISTURBANCE AND TERRORISM

A. INTRODUCTION AND HAZARD ANALYSIS

Civil disturbances can range in scale from the unrest of a small crowd to a large riot involving numerous people and spread over a large area. A permitted, orderly protest, people waiting in a long line or residents reacting to a public sector decision could result in civil disturbances ranging in scale from a public nuisance to a large scale destructive upheaval. Civil disturbances can include minor infractions such as disturbing the peace, illegal assembly, as well as more serious offence such as looting, possession of stolen property, robbery, assault, arson, brandishing weapons and murder. Perceived racial and social inequality and deep-seated political differences have the potential to create large scale civil disturbances such as the Los Angeles riots in April 1992. Under the right conditions, civil unrest can escalate to civil disaster.

If a civil disturbance the size of the Los Angeles riots were to involve Burbank, residents can expect a curfew and an interruption of some basic services. such as postal delivery and a slower emergency vehicle response time. Business operations could be disrupted and commercial structures could be damaged. Rioting could spread into residential areas threatening homes with vandalism, looting, arson and the personal safety of residents.

Terrorism also has the potential to wreak havoc upon our cities. The miniaturization of highly destructive weapons coupled with political unrest have made terrorism of increasing concern not only in Europe and the Middle East, but in American cities as well. The occurrence of terrorist threats and acts are on the rise.

Locations of civil disturbances and terrorism are usually high profile places which are likely to attract the most attention by the public, usually through media converge, thereby calling attention to the group's cause or objective.

B. HAZARD RESPONSE

The Fire and Police departments have specific policies that dictate response during a civil disturbance. At the first warning of a potential civil disturbance, the Emergency Operations Center is activated on a limited basis and operations are expanded if necessary. Based on the level of unrest the police decide if an area is safe for entry. Police officers escort BFD apparatus into unsafe areas within the City; Highway Patrol officers escort fire apparatus into unsafe areas outside the City boundary, as set out in the City's Mutual Aid Agreement. BFD personnel have been assigned body armor that is to be worn to a known civil disturbance. If the governor declares a state of emergency as the result of a riot or terrorist act, the City Council has the authority to impose a curfew and proclaim the existence or potential existence of a "local emergency". It is the responsibility of the Police Department to enforce the curfew. Police personnel can be put on 24-hour call during times of emergency.

The City has the capacity to detain 47 individuals in the City jail; makeshift detention facility could be provided at an alternate site, such as a park facility or a gymnasium or even a drained swimming pool. In addition, arrested individuals could be bussed to the Los Angeles County Jail. The police have a mobile command post which can be set up at the site of a disturbance.

During times of civil unrest, Police Department strategy is to monitor the City by stationing officers at the streets that traverse City boundaries and at the freeway off-ramps. This method of security was practiced during the Los Angeles riots of 1992.

The Burbank Police Department can call for assistance through mutual aid agreements with the Cities of Glendale, Pasadena, Los Angeles and San Fernando; if these cities are also experiencing local civil unrest it would be necessary to request aid through the State Emergency Aid System. The federal government can also provide National Guard forces to aid in maintaining the peace during large scale disasters and riots.

C. HAZARD MITIGATION

The Burbank Police Department has an intelligence officer who is responsible for maintaining a list of sensitive locations in the community which have a higher potential as terrorist targets--these are sites with wide exposure or critical facilities. The police maintain a liaison with the private security in those organizations.

Police presence at large gatherings or at potentially volatile events serves as a deterrent to civil disobedience. Continuous patrolling of the streets of Burbank serves as a deterrent to crime and creates an unwelcome environment for unlawful activity in the City. The Burbank Police are actively reaching out to the youth of the community to establish a partnership of mutual trust. Numerous public education programs are made available to the community through public and private schools, community meetings and neighborhood watch organizations.

D. POLICIES FOR DEALING WITH CIVIL UNREST AND TERRORISM

The overriding goal of this Safety Element with regard to Civil Unrest and terrorism is to achieve and maintain a safe and secure environment in the City of Burbank for all residents, and to reduce the number of lives lost, injuries and amount of property damage. The following policies are intended to support this goal.

- P1. Respond to the changing safety needs and considerations resulting from Burbank's increasingly urban character and the influences of surrounding communities.
- P2. Maintain the City's high levels of police and fire protection and rescue practices by providing the Police and Fire Departments with adequate equipment and updated training programs.

Objective - Maintain an average police response time to emergency calls for service of under three (3) minutes.

Objective - Maintain a maximum response time for fire suppression services of five minutes.

- P3. Reduce the underlying causes of crime and opportunities for criminal activity through physical design standards and crime prevention programs and policies.
- P4. Continue and expand upon current safety education and public information programs for residents of Burbank.

X. GLOSSARY OF ACRONYMS

AEP	Airport Emergency Plan
APSSZ	Alquist-Priolo Special Study Zone
B-G-P	Burbank-Glendale-Pasadena Airport
BFD	Burbank Fire Department
Cal/OSHA	California Division of Occupational Safety and Health
CDMG	California Division of Mines and Geology
EOC	Emergency Operations Center
EOP	City of Burbank's Multi-Hazard Emergency Operations Plan
EPA	Federal Environmental Protection Agency
FAA	Federal Aviation Agency
FEMA	Federal Emergency Management Agency
HMIS	Hazardous Materials Inventory Statement
HMMP	Hazardous Materials Management Plan
ICBO	International Conference of Building Officials
LACDA	Los Angeles County Drainage Area
LADWP	City of Los Angeles Department of Water and Power
M	Magnitude (Seismic Magnitude)
MFZ	Mountain Fire Zone
MM	Modified Mercalli (Seismic Intensity)
MWD	Metropolitan Water District of Southern California

OES	Governor's Office of Emergency Services
PSD	City of Burbank Public Service Department
RMP	Risk Management Program
RMPP	Risk Management and Prevention Program
SCAQMD	South Coast Air Quality Management District
UBC	Uniform Building Code
USGS	United States Geological Survey

TECHNICAL APPENDICES

- I. Crime Statistics, City of Burbank, prepared by City of Burbank Police Department
- II. Modified Mercalli Intensity Maps, prepared by Leighton and Associates, Inc., Geotechnical and Environmental Engineering Consultants
- III. Probabilistic Ground Motion Analysis, prepared by Leighton and Associates, Inc., Geotechnical and Environmental Engineering Consultants
- IV. Deterministic Seismic Parameter Analysis, prepared by Leighton and Associates, Inc., Geotechnical and Environmental Engineering Consultants
- V. Glossary of Terms for Seismic Safety Hazard
- VI. References for Seismic Safety Hazard

CRIME STATISTICS, CITY OF BURBANK

It is helpful to look at the crime statistics for the City of Burbank as they compare to the cities of Glendale, Pasadena, Inglewood, Santa Monica, Torrance and Los Angeles. The statistics below are based on the FBI Crime Index, which is the number reported for each of the following crimes: murder, rape, robbery, aggravated assault, burglary, theft and auto theft.

Burbank's 1994 crime index per 1,000 population was 47.0, 31.9 percent below the average rate for the comparison cities. Burbank's seven-year average crime index per 1,000 population was 45.5, which is 40.1 percent below the averages of the comparison cities. The following table is a comparison of the crime index and the crime index per 1,000 population for Burbank and comparison cities since 1988.

TABLE 1 CRIME INDEX							
	1988	1989	1990	1991	1992	1993	1994
Burbank	3,992	3,769	4,107	4,656	4,648	4,706	4,640
Glendale	8,641	9,227	8,785	9,222	8,282	8,215	7,352
Inglewood	7,833	8,549	8,675	9,482	9,524	8,401	7,205
Pasadena	9,243	10,641	9,642	9,512	10,168	9,684	9,207
Santa Monica	9,800	10,000	10,200	10,396	10,523	10,891	8,887
Torrance	7,383	7,689	7,958	8,246	8,399	8,759	8,106
Los Angeles	292,000	295,181	326,919	346,224	338,532	320,064	282,324
Source: Burbank Police Department, 1994							

TABLE 2 CRIME INDEX PER 1,000 POPULATION								
	1988	1989	1990	1991	1992	1993	1994	AVG.
Burbank	42.8	40.2	43.1	48.8	48.0	48.4	47.0	45.5
Glendale	52.3	55.8	49.2	50.2	44.9	44.0	38.7	47.9
Inglewood	68.9	78.6	79.7	84.9	84.7	74.0	63.4	76.3
Pasadena	70.1	78.8	73.3	71.8	76.2	72.1	73.7	73.7
Santa Monica	92.4	94.6	107.9	116.3	120.4	125.3	102.3	108.5
Torrance	49.9	56.3	59.7	61.8	62.7	64.8	58.3	59.1
Los Angeles	84.9	93.2	94.0	97.9	94.6	88.7	78.0	90.2
Source: Burbank Police Department, 1994								

The table below compares selected criminal offenses in the City of Burbank for the years 1993 and 1994.

TABLE 3 1993-1994 CRIME STATISTICS					
FBI CLASSIFICATION OF PART 1 OFFENSES	NUMBER OF OFFENSES				
	1994	1993	CHANGE		
			#	%	
1a Murder/Non-Neg Manslaughter	4	5	-1	-20%	
1b Manslaughter	0	0	0	0%	
2 Forcible Rape	21	16	5	31%	
3 Robbery	189	209	-20	-10%	
4a Aggravated Assault	240	263	-23	-9%	
4b Other Assault	633	529	104	20%	
5 Burglary	496	665	-169	-25%	
6 Theft	2,669	2,556	113	4%	
7 Auto Theft	1,021	992	29	3%	
TOTAL	5,273	5,235	38	1%	
INDEX CRIME	4,640	4,706	-66	1%	
Arson	21	113	-92	-81%	
Source: Burbank Police Department					

APPENDIX II

MODIFIED MERCALLI INTENSITY MAPS

MODIFIED MERCALLI INTENSITY MAPS

This appendix presents a series of Modified Mercalli Intensity Maps for maximum credible earthquakes generated along faults near the City of Burbank, including the Verdugo, Hollywood, San Fernando and Sierra Madre. The maps show which areas of the City will hypothetically experience the highest intensities, and therefore worst damage, from a given earthquake. The maps are designed to be most useful for urban and disaster planning.

Verdugo Fault Earthquake Scenario

For the purposes of this scenario, the Verdugo fault is assumed to break along its entire length. Ground distortion is likely to occur along preexisting fault traces (Plate 1, in pocket).

Figure II-1 and II-2 show three-dimensional representations of the Modified Mercalli intensities expected to be generated by a maximum credible earthquake on this fault. The seismic intensities shown on Figure II-1 do not incorporate the 1.4 acceleration factor of Campbell, while those on Figure II-2 do. A comparison of the two figures shows that the 1.4 acceleration factor results in an overall increase in the expected intensities by approximately $\frac{1}{2}$ intensity unit, and an increase in the area of the City exposed to high intensities.

Figure II-3 shows the intensity values as contours on a map of the City of Burbank, while Figure II-4 contours the worst-case intensities (calculated using Campbell's acceleration factor). Both figures show the locations of liquefiable areas and areas where the amplification of seismic energy may be most critical. Earthquake intensities in general are higher in the center of the City and decrease towards the Verdugo Hills in the northeast and towards the southwest. Although considerable damage would be expected throughout the City in the worst-case scenario, severe damage would be concentrated in buildings not engineered to withstand strong earthquakes.

Figure II-5 shows the peak horizontal ground accelerations expected to result from a M_L 6.7 earthquake. Figure II-6 shows the same scenario, but incorporating the 1.4 acceleration factor of Campbell. A probabilistic assessment of ground motion for the Verdugo fault using various reverse fault accelerations is included in Appendix III. Anderson and Luco (1983) have found that sites located directly above the rupture surface of dipping faults experience higher than expected acceleration amplitudes. The worst-case scenarios presented herein for the Verdugo fault should, therefore, be used preferentially for urban planning purposes. Although liquefaction of susceptible sediments could occur in either scenario, the high accelerations associated with the worst-case scenario could result in liquefaction of sediments located up to 50 feet below the ground surface.

VERDUGO FAULT

Magnitude of the Maximum Credible Earthquake = 6.7

Length of Fault = 26 km

Duration of Shaking = 21 seconds

Probability of Maximum Credible Earthquake Occurring in 100 Years 6.2%

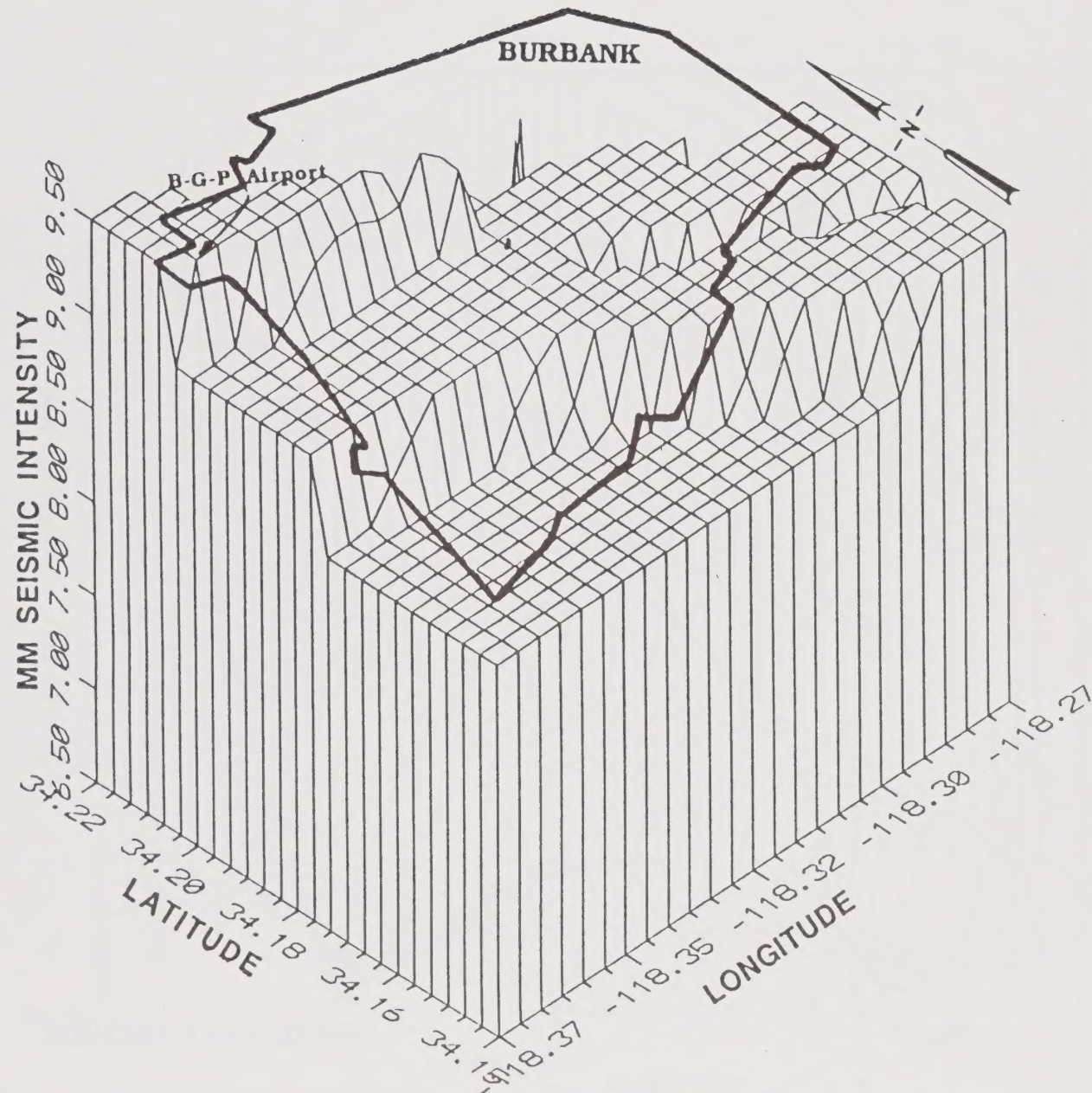


Figure 11-1

A 3-dimensional plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.7 on the Verdugo fault. The half unit of intensity represents the upper half unit of each intensity value.

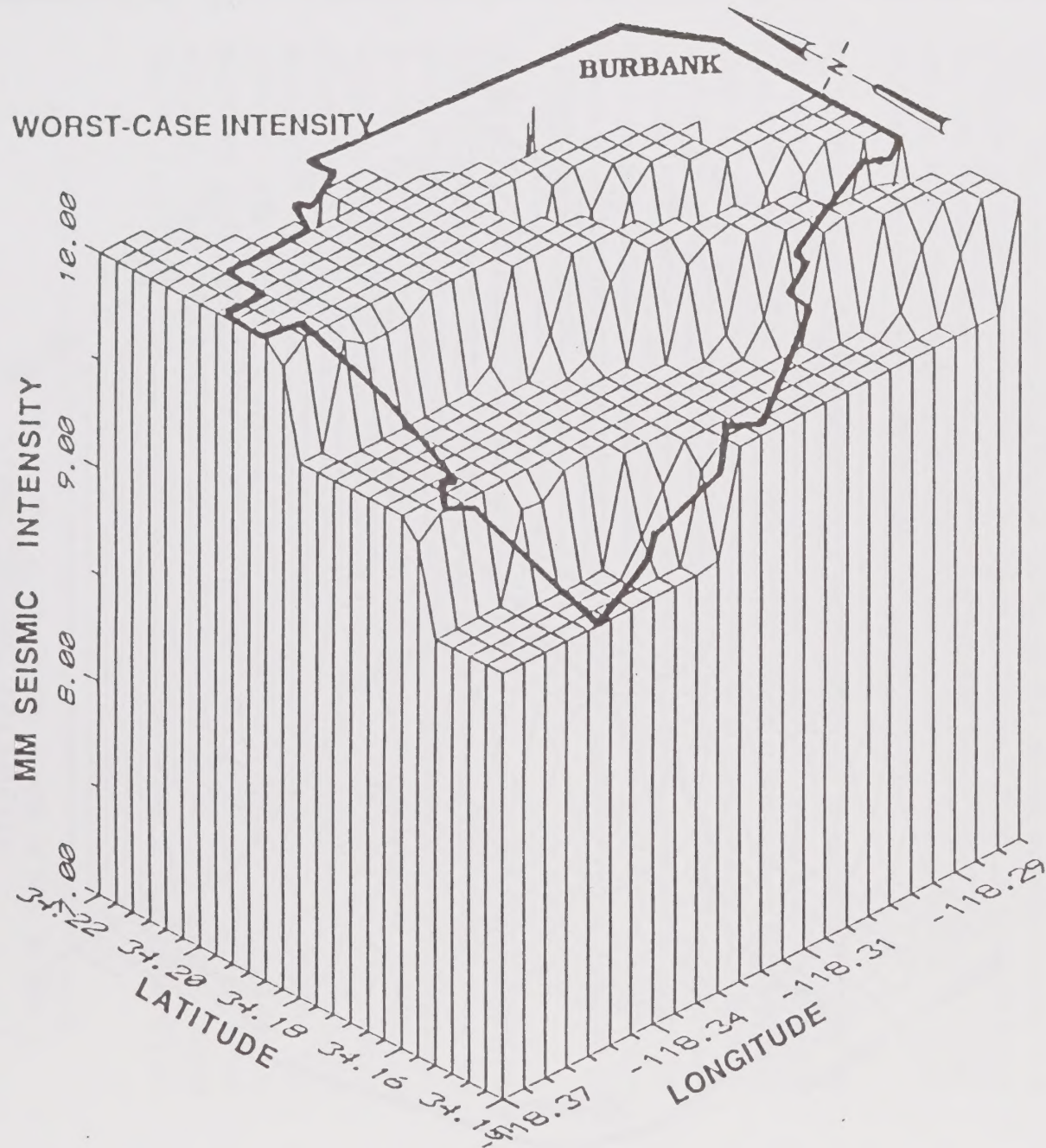


Figure 11-2

A 3-dimensional plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.7 on the Verdugo fault using Campbell's (1988) acceleration factor for reverse faults. The half unit of intensity represents the upper half unit of each intensity value.

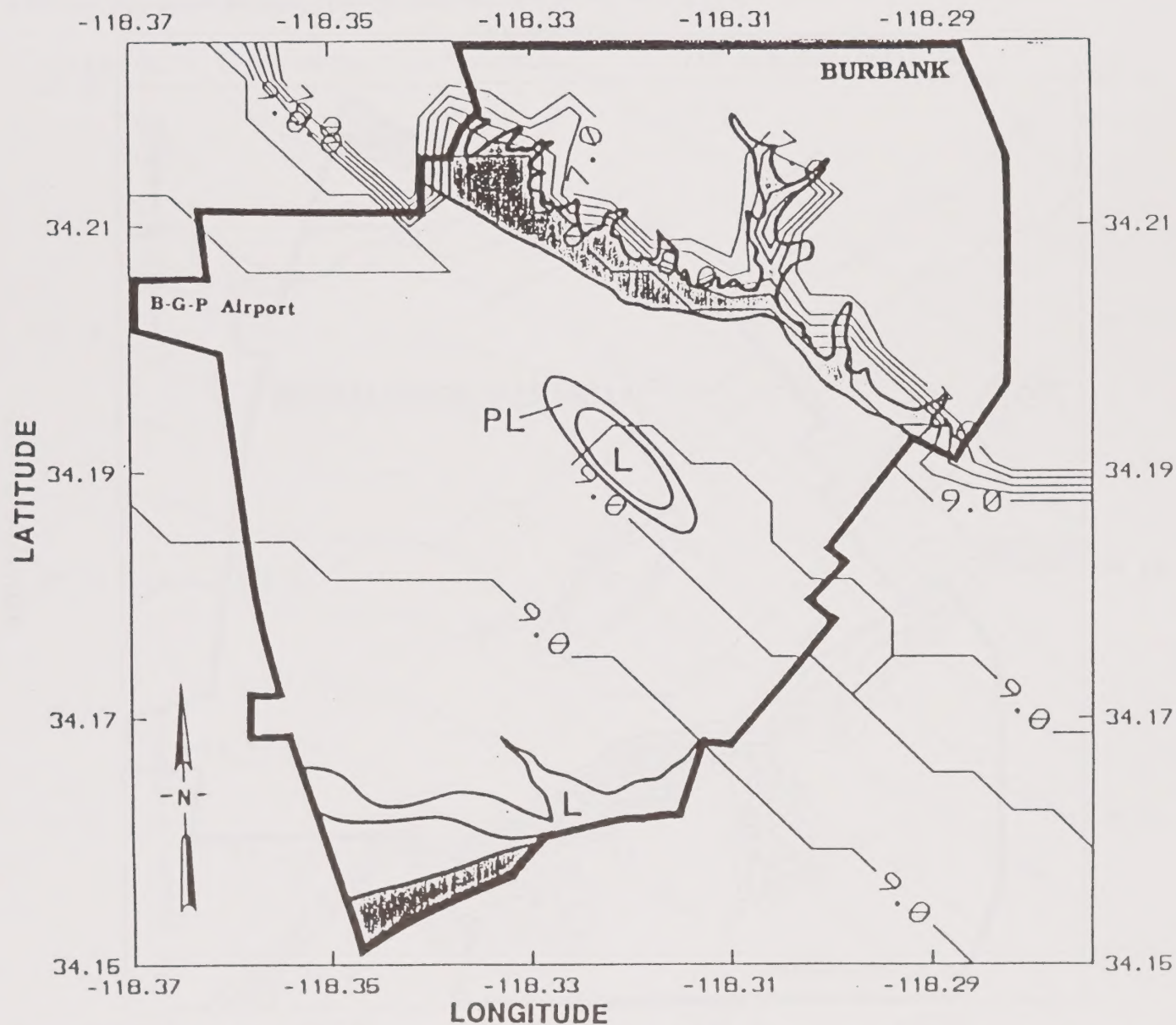
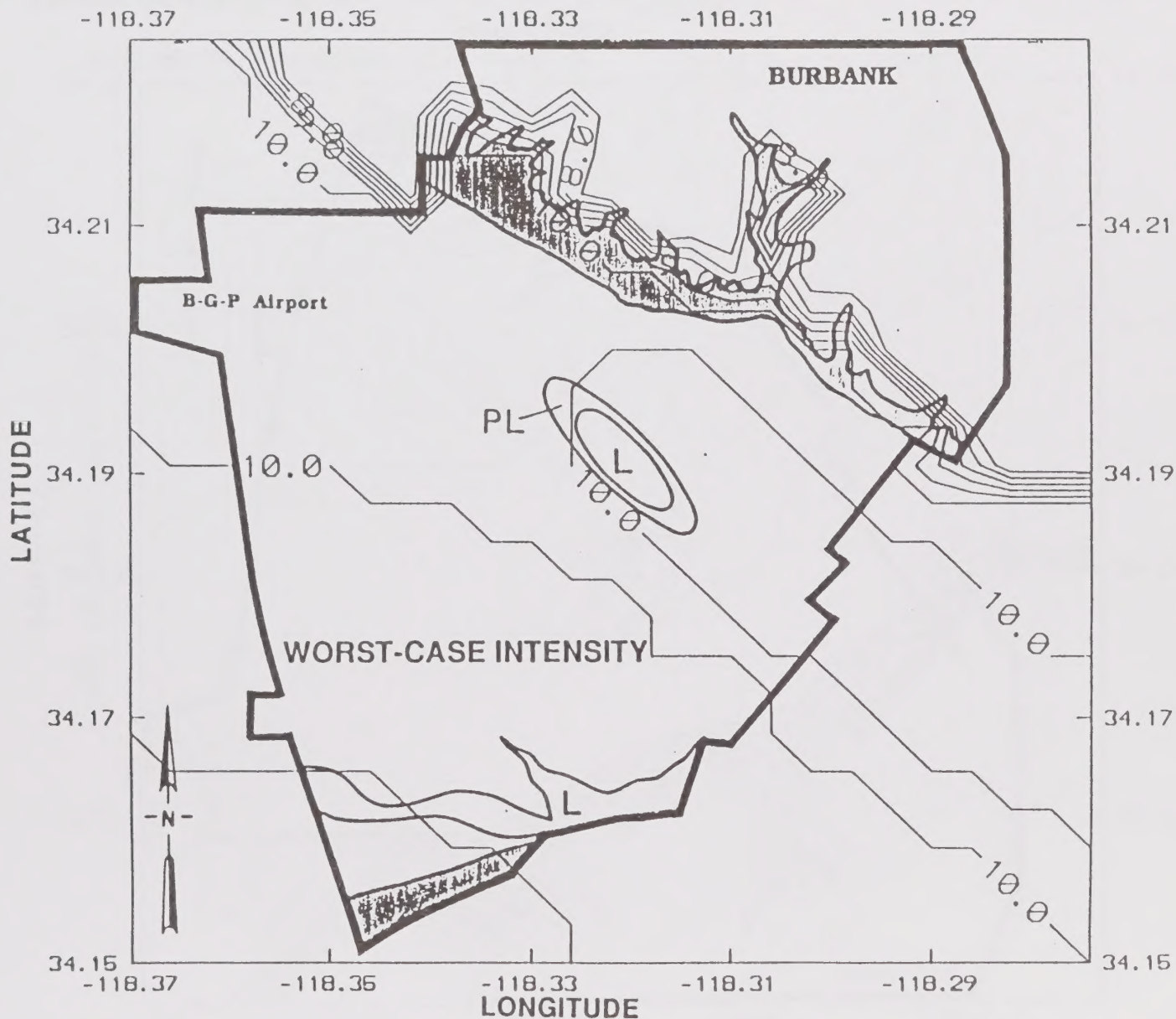


Figure 11-3

A contour plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.7 on the Verdugo fault. The shaded areas are zones of possible site amplification. Liquefiable and potentially liquefiable areas are shown with the symbols L and PL, respectively. The half unit of intensity represents the upper half unit of each intensity value. The boundaries for the various levels of intensity represent a smooth variation in intensity, and should not be taken to be as sharply as they are herein defined.



A contour plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.7 on the Verdugo fault using Campbell's (1988) acceleration factor for reverse faults. The shaded areas are zones of possible site amplification. Liquefiable and potentially liquefiable areas are shown with the symbols L and PL, respectively. The half unit of intensity represents the upper half unit of each intensity value. The boundaries for the various levels of intensity represent a smooth variation in intensity, and should not be taken to be as sharply as they are herein.

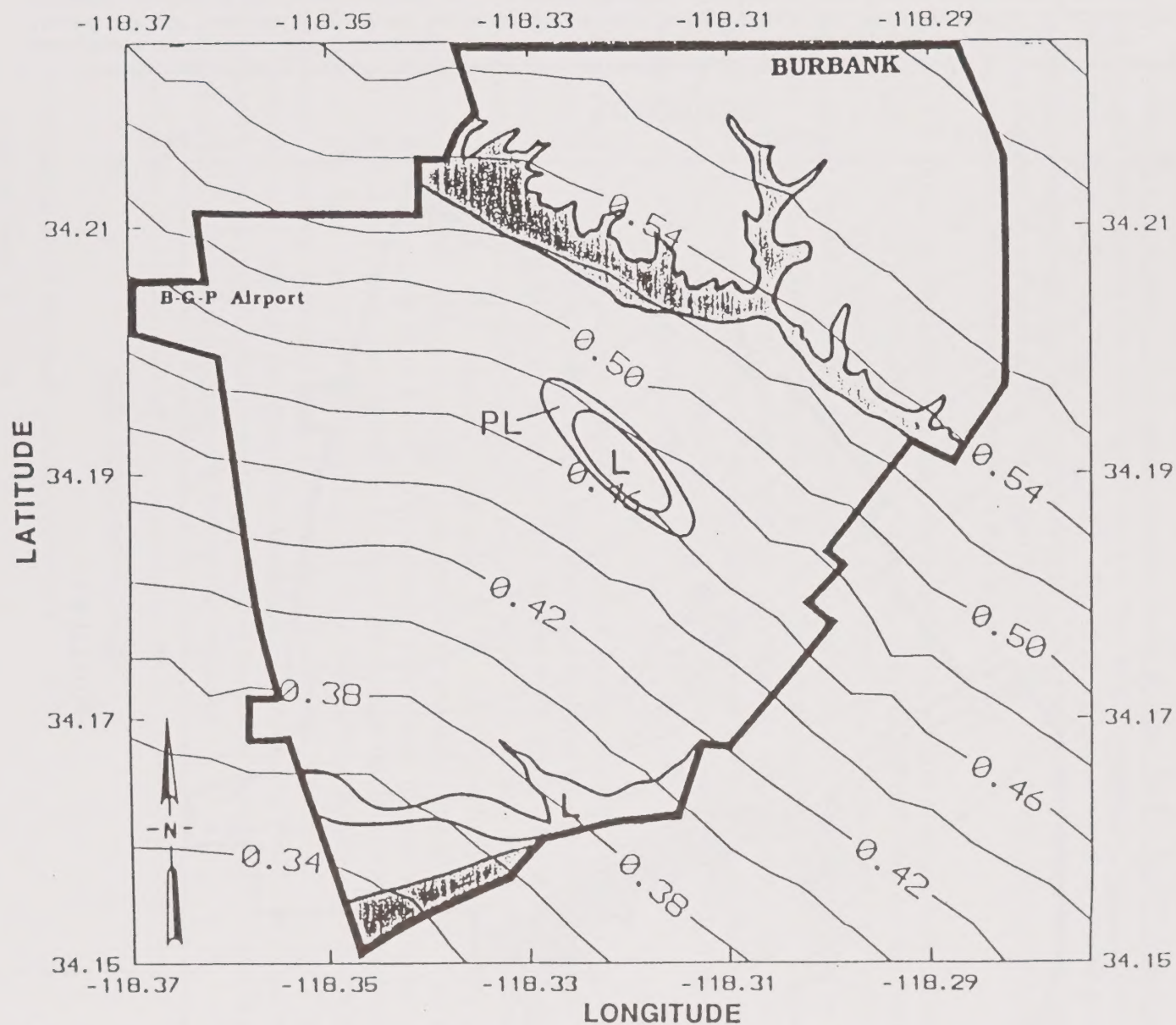


Figure 11-5

Contour map of peak ground accelerations from an earthquake of Magnitude 6.7 on the Verdugo fault. The shaded areas are zones of possible site amplification. Liquefiable and potentially liquefiable areas are shown with the symbols L and PL, respectively. The half unit of intensity represents the upper half unit of each intensity value. The boundaries for the various peak ground accelerations represent a smooth variation in acceleration, and should not be taken to be as sharply as they are herein defined.

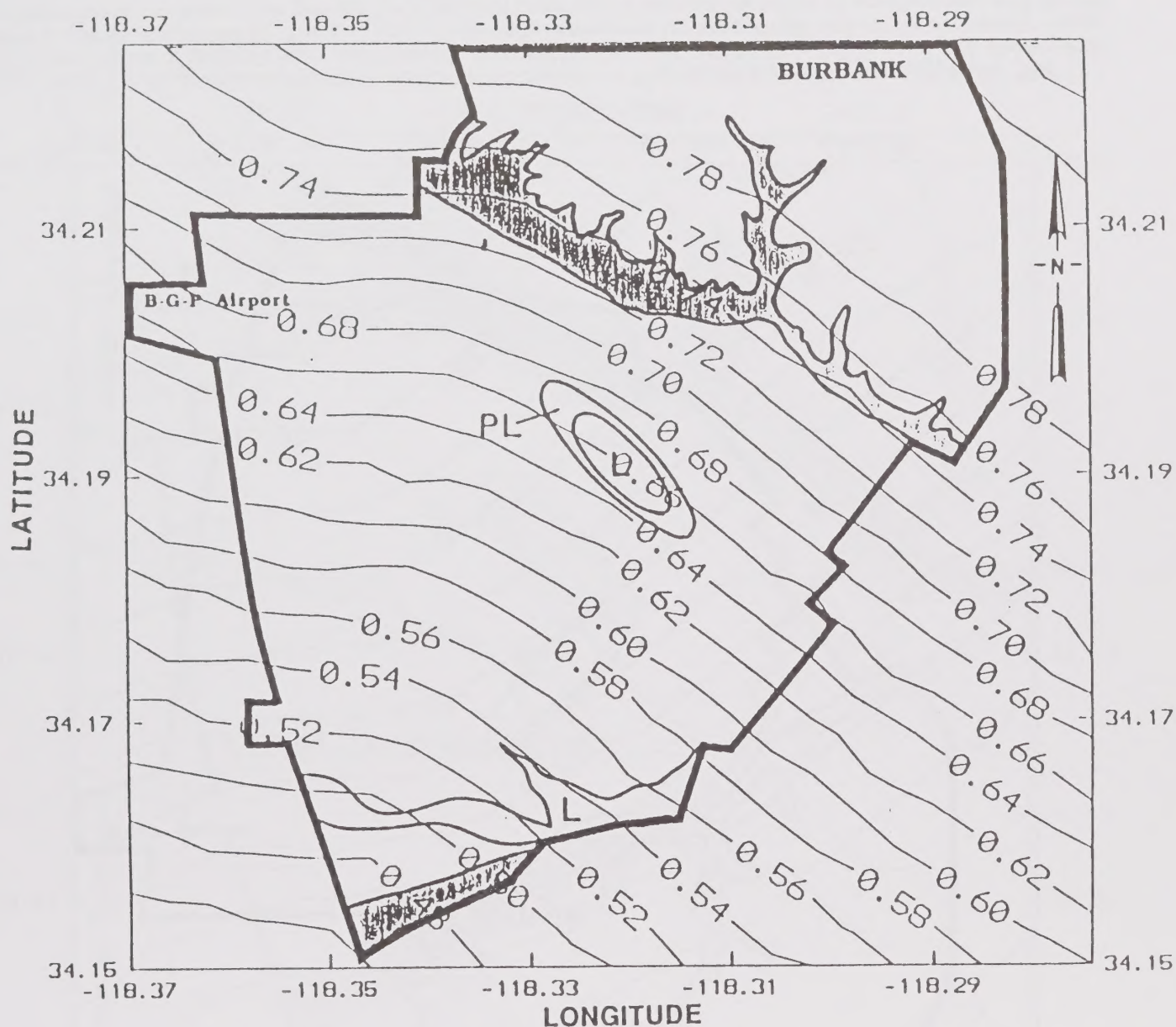


Figure II-6

Contour map of peak ground accelerations from an earthquake of Magnitude 6.7 on the Verdugo fault using Campbell's acceleration factor for reverse faults. The shaded areas are zones of possible site amplification. Liquefiable and potentially liquefiable areas are shown with the symbols L and PL, respectively. The half unit of intensity represents the upper half unit of each intensity value. The boundaries for the various peak ground accelerations represent a smooth variation in acceleration, and should not be taken to be as sharply as they are herein defined.

San Fernando Fault Earthquake Scenario

The expected return period for the maximum credible event ($M_L = 6.5$) on the San Fernando fault is 200 years. A 39 percent probability of such an event occurring in 100 years makes this fault located to the northwest of the City, a candidate for an earthquake scenario. The seismogenic zone in the 1971 San Fernando Earthquake was about five kilometers below the earth's surface, along a fault plane dipping 30 degrees. This source depth and fault dip were used to model the hypothetical earthquake source for this scenario. The seismic intensities felt in the City of Burbank as a result of the 1971 earthquake ($M_L = 6.4$) can be compared to the predicted intensities presented in this study.

Figure II-7 shows a three-dimensional characterization of the seismic intensities expected to be felt in Burbank from a maximum credible earthquake on the San Fernando fault. The intensities shown do not reflect the 1.4 acceleration factor of Campbell. Figure II-8 on the other hand includes Campbell's correction factor. AS with the Verdugo fault earthquake scenario, the 1.4 acceleration factor results in overall higher intensity values, and an increase in the area of the City experiencing high ground motions. Higher than expected accelerations during the San Fernando and the 1987 Whittier Narrows Earthquakes were used by Campbell to generate the 1.4 acceleration factor.

Figures II-9 and II-10 show the predicted intensity values as contours on the City of Burbank. These figures also show the areas of the city prone to liquefaction and areas where amplification of the ground motion may occur. Most of the City is expected to experience intensities ranging from 7.5 to 8.0 in a worst-case scenario (such as that shown in Figure II-10 which includes Campbell's acceleration factor). These intensities are similar to the MM intensities of 7 to 8 experienced in Burbank during the 1971 event. The actual intensity patterns of the 1971 event cannot be correlated to those shown here because the isoseismal maps of the San Fernando Earthquake are regional in nature, lacking adequate resolution. Damage resulting from a maximum credible earthquake is expected to be moderate, and probably less than that experienced during the 1971 earthquake since better construction quality, improved disaster response planning and seismic rehabilitation have since reduced the City's vulnerability.

SAN FERNANDO FAULT	
Magnitude of the Maximum Credible Earthquake	= 6.5
Length of Fault	= 17 km
Duration of Shaking	= 19 seconds
Probability of Maximum Credible Earthquake Occurring in 100 Years	39%

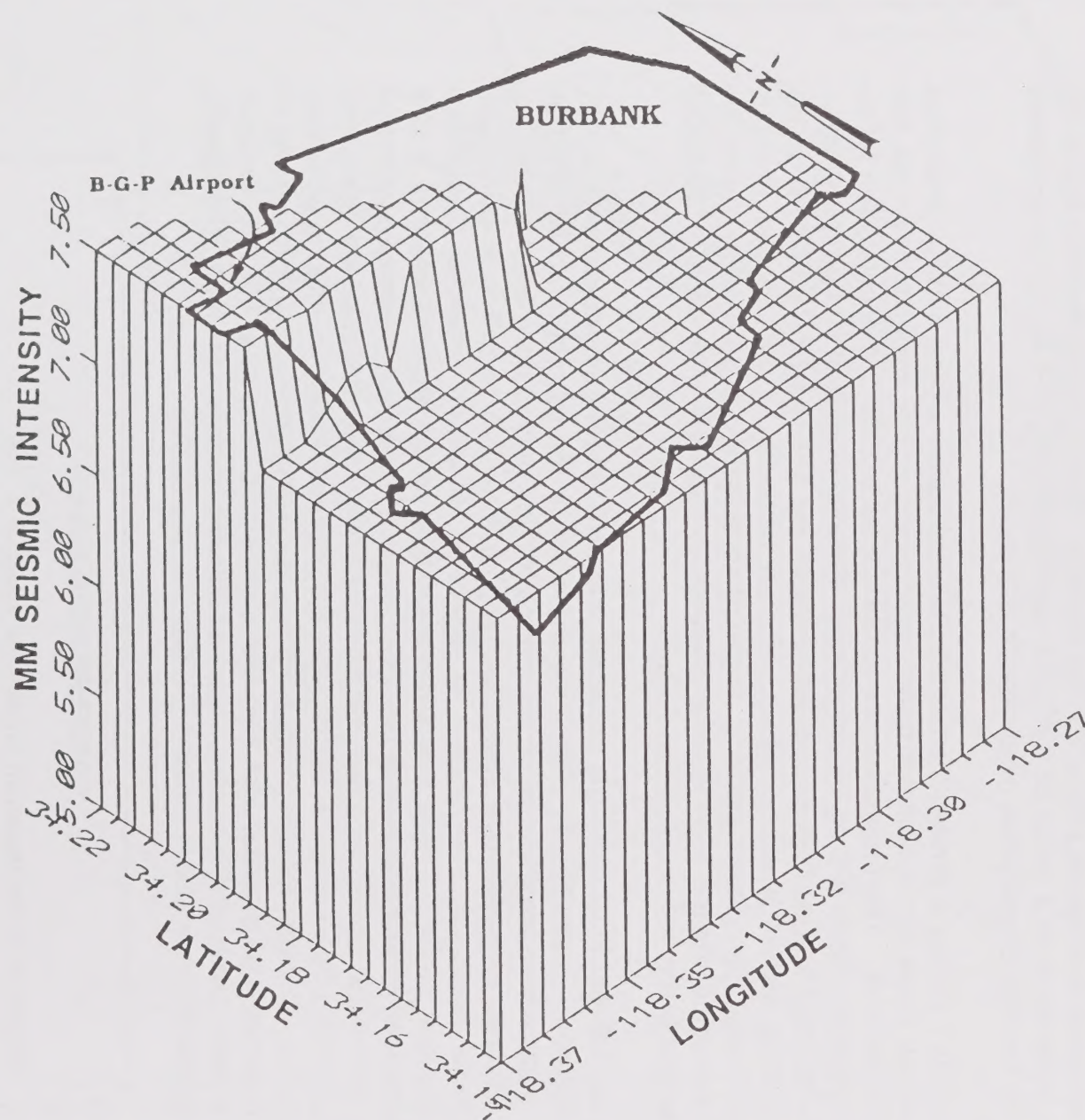


Figure 11-7

A 3-dimensional plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.6 on the San Fernando fault. The half unit of intensity represents the upper half unit of each intensity value.

WORST-CASE INTENSITY

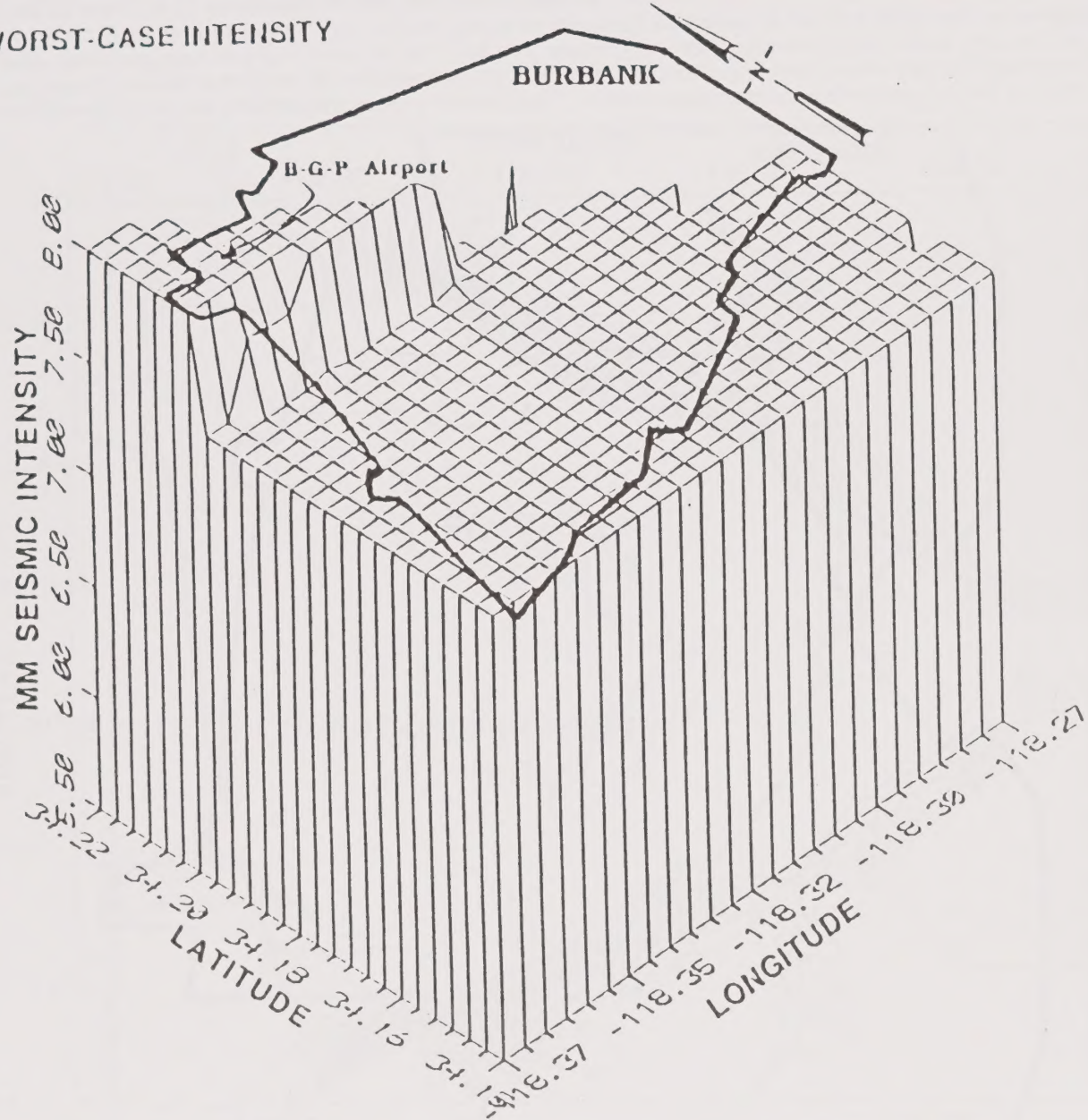
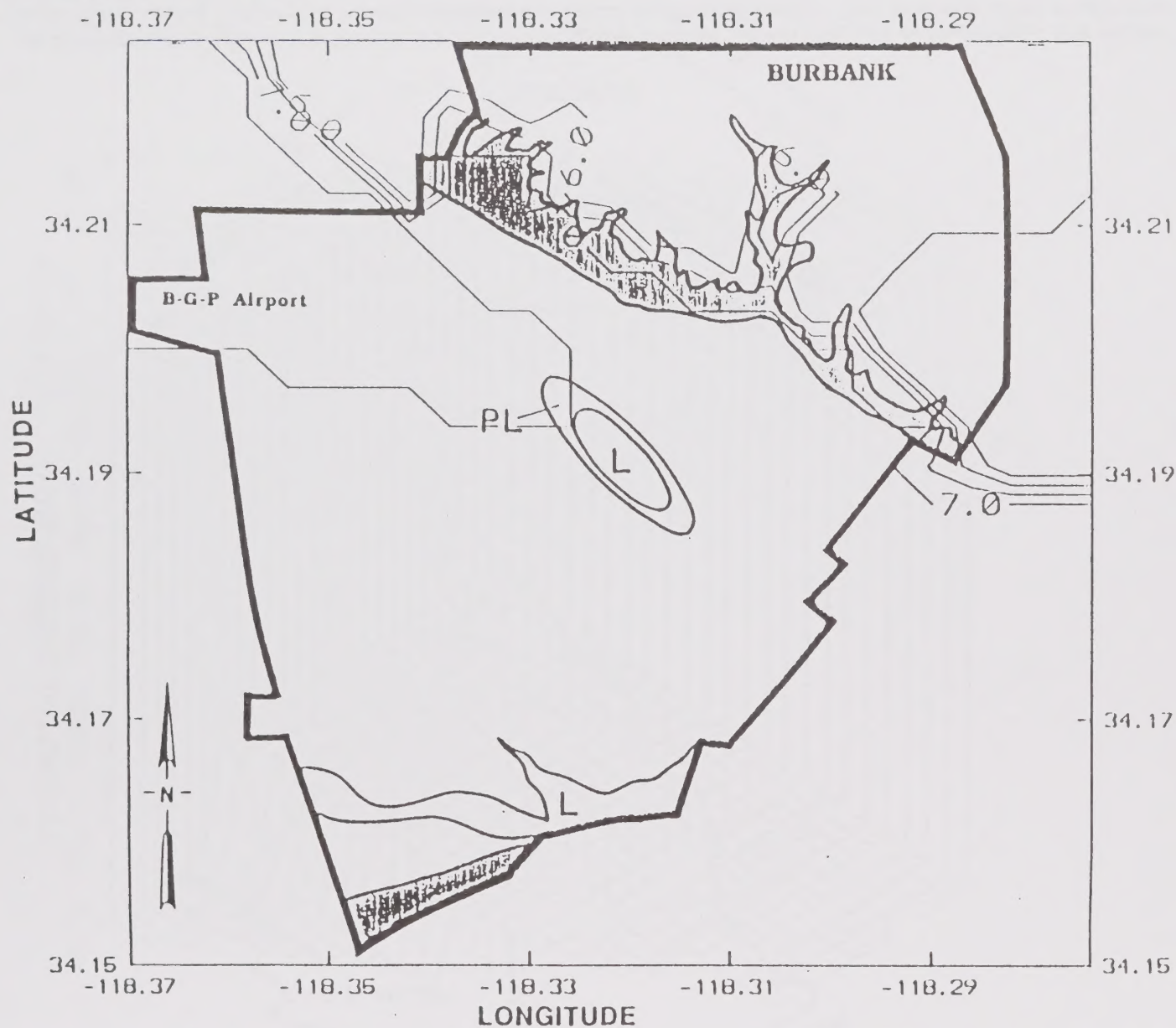


Figure II-8

A 3-dimensional plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.6 on the San Fernando fault using Campbell's (1988) acceleration factor for reverse faults. The half unit of intensity represents the upper half unit of each intensity value.



A contour plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.6 on the San Fernando fault. The shaded areas are zones of possible site amplification. Liquefiable and potentially liquefiable areas are shown with the symbols L and PL, respectively. The half unit of intensity represents the upper half unit of each intensity value. The boundaries for the various levels of intensity represent a smooth variation in intensity, and should not be taken to be as sharply as they are herein defined.

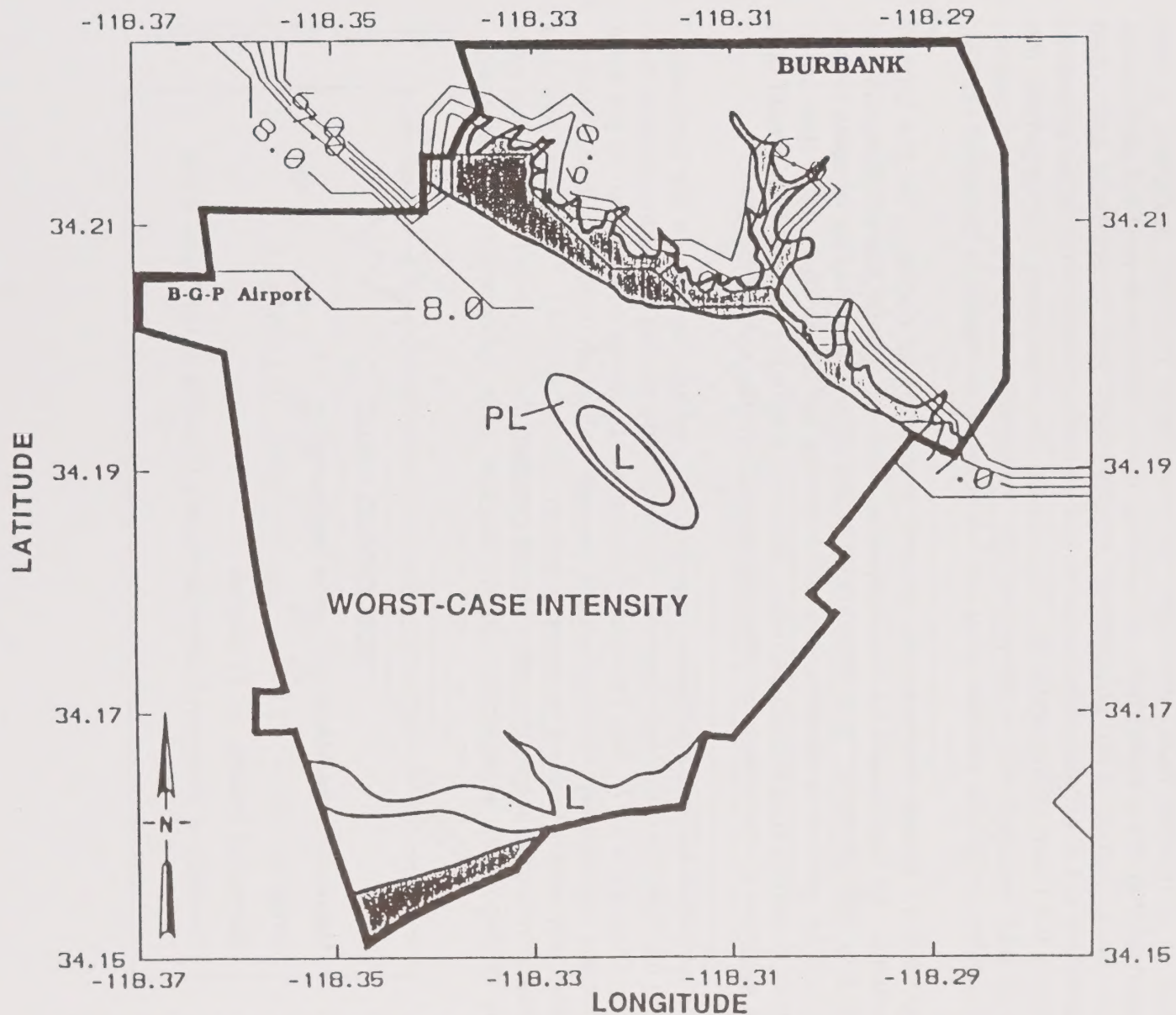


Figure II-10

A contour plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.6 on the San Fernando fault using Campbell's (1988) acceleration factor for reverse faults. The shaded areas are zones of possible site amplification. Liquefiable and potentially liquefiable areas are shown with the symbols L and PL, respectively. The half unit of intensity represents the upper half unit of each intensity value. The boundaries for the various levels of intensity represent a smooth variation in intensity, and should not be taken to be as sharply as they are herein defined.

Hollywood Fault Earthquake Scenario

An earthquake on the Hollywood fault occurs, on average, every 1,500 to 2,000 years. The probability of a maximum credible earthquake occurring in the next 100 years on the Hollywood fault is approximately six percent. The Hollywood fault is a reverse fault, therefore, for worst-case planning purposes, it was assumed that the ground motions resulting from a maximum credible earthquake will have higher than anticipated accelerations and intensities, and used Campbell's 1.4 acceleration factor to calculate the seismic intensities shown in Figure II-11 and in Appendix III. To develop the worst-case intensity data, the fault was modeled with a 50 degree dip. Appendix III also includes the seismic intensities calculated without using the 1.4 acceleration factor of Campbell (1988).

Figure II-12 shows the expected seismic intensities as contours on the City of Burbank. An earthquake on the Hollywood fault will impact the southern part of the City preferentially. The liquefaction-prone area along the Los Angeles Rivers would be subject to Modified Mercalli intensity values of 10 to 10.5 that could result in severe liquefaction damage. Mid-rise and high-rise buildings would also be exposed to the effects of site amplification in this part of the City.

The predicted seismic intensities drop gradually across the City to the northwest, with most of the urbanized section of Burbank experiencing intensities greater than 9.0. During the 1971 San Fernando Earthquake, buildings constructed of pre-case concrete suffered significant structural damage from such levels of ground motion, especially when located in areas prone to ground failure. Future damage and disaster response planning studies should consider the Hollywood fault, along with the Verdugo fault, as essential, worst-case scenarios that merit further attention.

HOLLYWOOD FAULT

Magnitude of the Maximum Credible Earthquake = 6.4

Length of Fault = 17 km

Duration of Shaking = 18 seconds

Probability of Maximum Credible Earthquake Occurring in 100 Years 6.2%

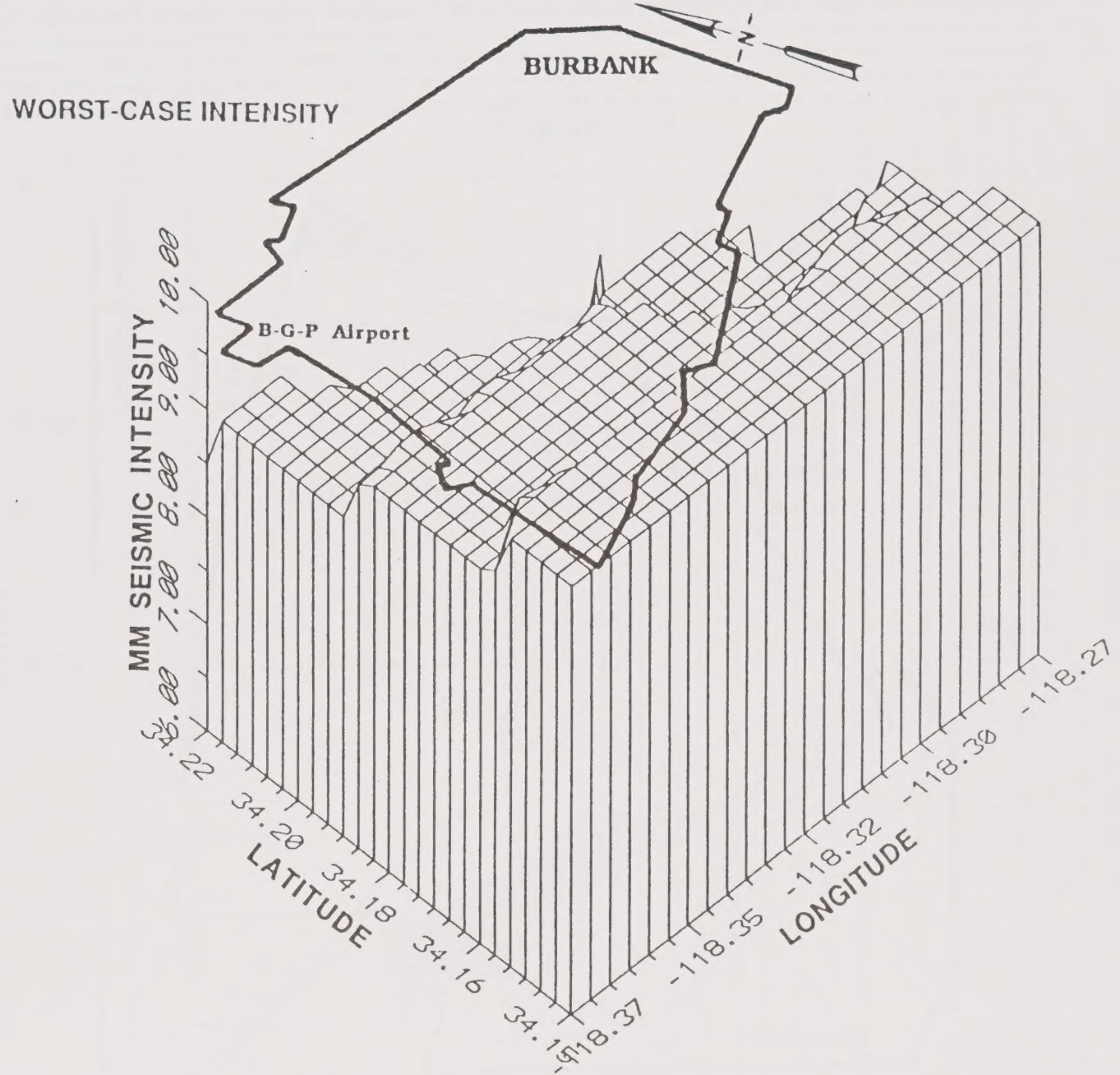
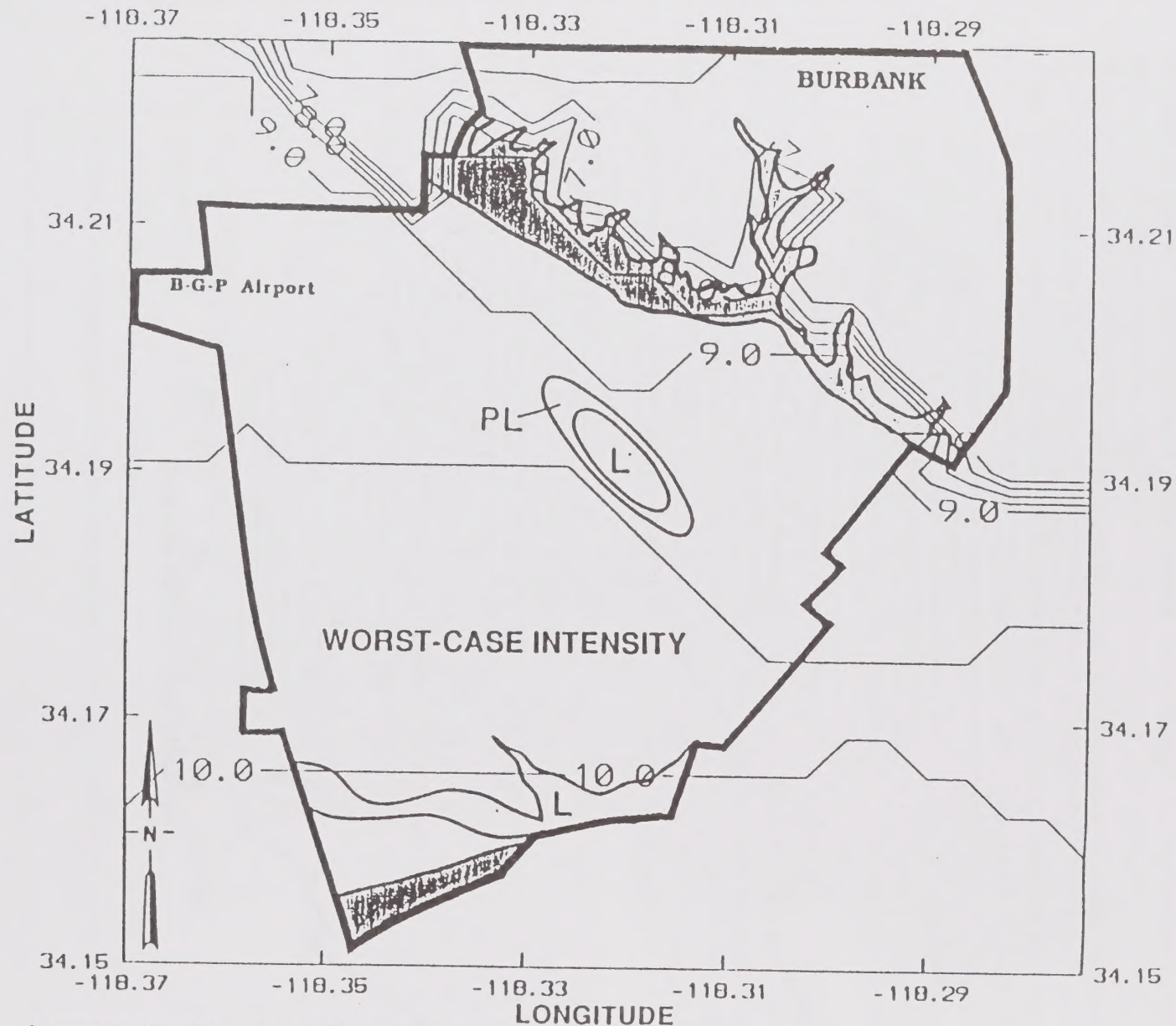


Figure II-11

A 3-dimensional plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.4 on the Hollywood fault using Campbell's (1988) acceleration factor for reverse faults. The half unit of intensity represents the upper half unit of each intensity value.



A contour plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.4 on the Hollywood fault using Campbell's (1988) acceleration factor for reverse faults. The shaded areas are zones of possible site amplification. Liquefiable and potentially liquefiable areas are shown with the symbols L and PL, respectively. The half unit of intensity represents the upper half unit of each intensity value. The boundaries for the various levels of intensity represent a smooth variation in intensity, and should not be taken to be as sharply as they are herein defined.

Figure II-12

Sierra Madre Fault Earthquake Scenario

The segment of the Sierra Madre fault closest to the City of Burbank is estimated to generate a maximum credible earthquake every 5,000 years. The probability of such an earthquake occurring in the next 100 years is 2.5 percent. For the purposes of this study and to generate the worst-case intensity values, this fault was modeled as having a 50 degree dip. The Sierra Madre fault is a reverse fault, therefore, Campbell's (1988) 1.4 acceleration factor was included in the computation of the seismic intensities shown in Figure II-13.

Maximum Modified Mercalli seismic intensities of 8.5 to 9.0 are predicted to be generated by a maximum credible earthquake with a magnitude of 6.4 on this fault. The intensity contours shown in Figure II-14 decrease towards the north. Figure II-14 also shows those areas prone to liquefaction and areas most likely to experience the effects of seismic amplification. An earthquake on the Sierra Madre is less likely to cause liquefaction-related damage than an earthquake on the Verdugo or Hollywood faults. However, for land use and response planning purposes, areas of potential ground failure in the City should be considered at risk regardless of the earthquake scenario. The same philosophy applies to ground rupture hazards in the City (see Plat 1, in pocket). The maximum credible earthquake on the Sierra Madre fault should be considered in all probabilistic and dynamic seismic analyses that are part of the design requirements for a project proposed in the City.

SIERRA MADRE FAULT

Magnitude of the Maximum Credible Earthquake = 6.4

Length of Fault = 14 km

Duration of Shaking = 19 seconds

Probability of Maximum Credible Earthquake Occurring in 100 Years 2.5%

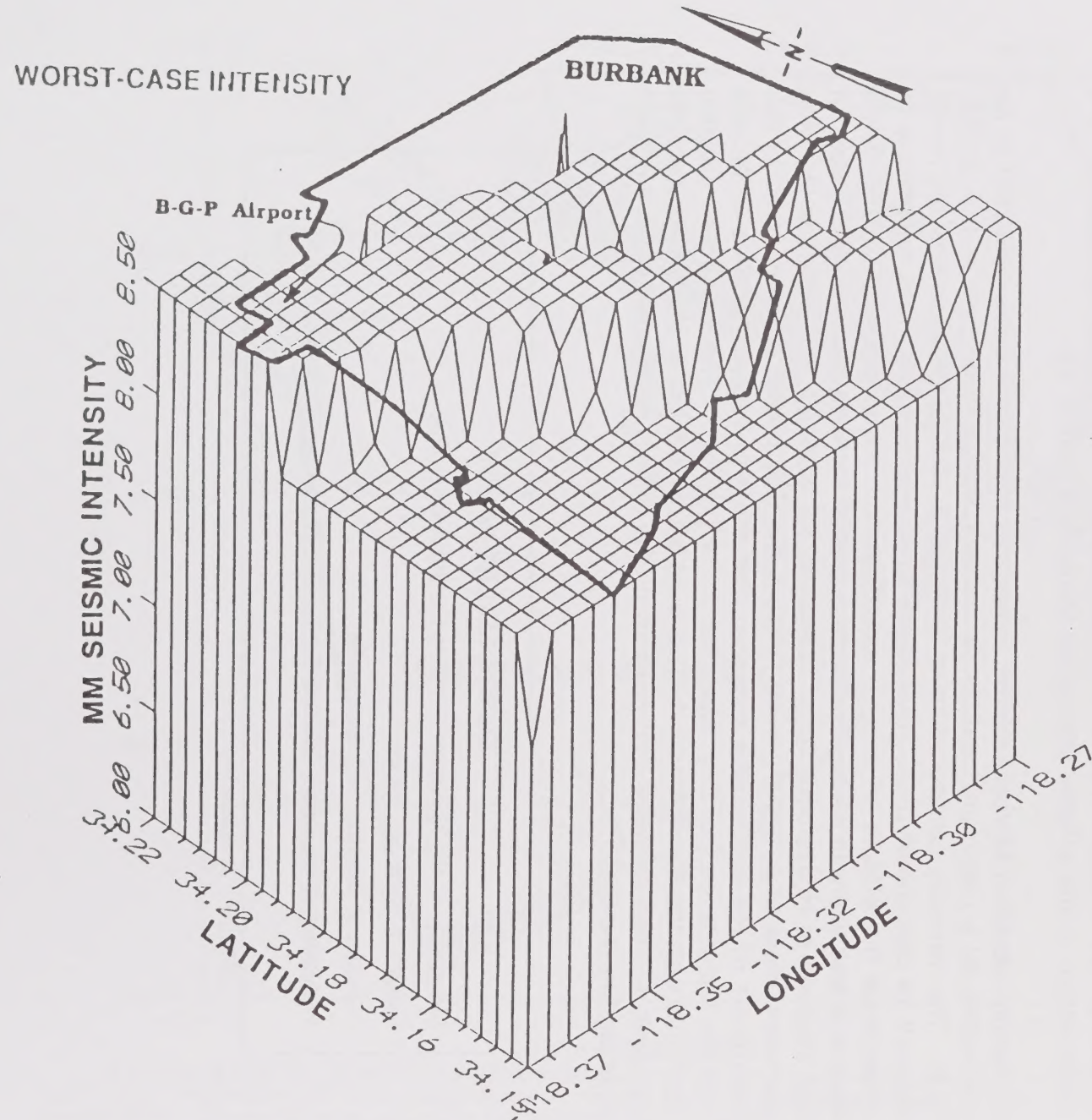


Figure II-13

A 3-dimensional plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.4 on the Sierra Madre fault using Campbell's (1988) acceleration factor for reverse faults. The half unit of intensity represents the upper half unit of each intensity value.

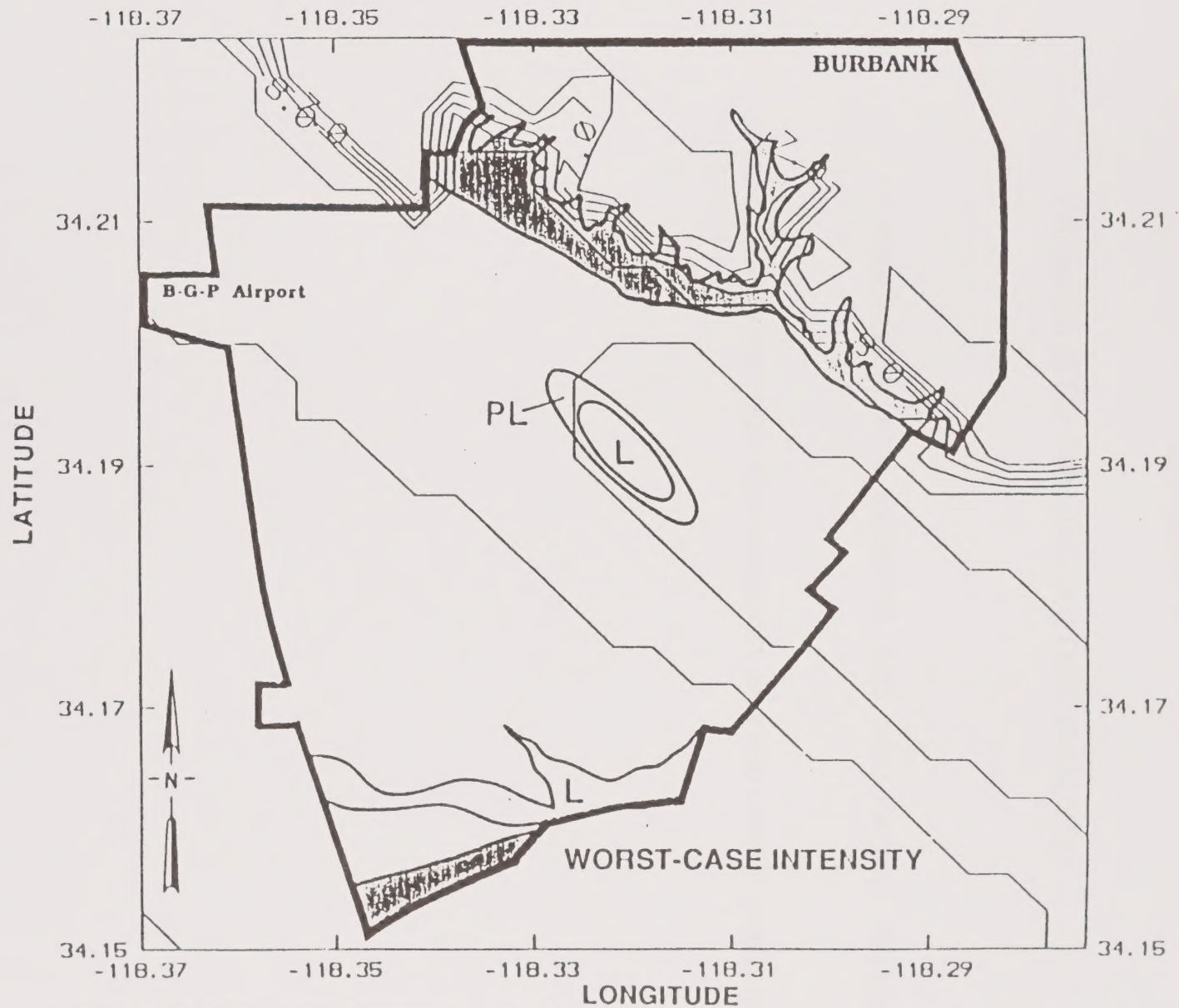


Figure II-14

A contour plot of the Modified Mercalli Intensity Map for an earthquake of Magnitude 6.4 on the Sierra Madre fault using Campbell's (1988) acceleration factor for reverse faults. The shaded areas are zones of possible site amplification. Liquefiable and potentially liquefiable areas are shown with the symbols L and PL, respectively. The half unit of intensity represents the upper half unit of each intensity value. The boundaries for the various levels of intensity represent a smooth variation in intensity, and should not be taken to be as sharply as they are herein defined.

APPENDIX III

PROBABILISTIC GROUND MOTION ANALYSIS

- A. NO CONSIDERATION FOR VERDUGO AND HOLLYWOOD REVERSE FAULTING**
- B. SPECIAL CONSIDERATION FOR VERDUGO AND HOLLYWOOD REVERSE FAULTING**

A. PROBABILISTIC GROUND MOTION ANALYSIS

**NO CONSIDERATION FOR VERDUGO AND HOLLYWOOD
REVERSE FAULTING**

PROBABILISTIC GROUND MOTION ANALYSIS

NO CONSIDERATION FOR VERDUGO AND HOLLYWOOD REVERSE FAULTING
COORDINATES: LAT = 34.18 LONG = 118.34

M1: LOWER BOUND MAGNITUDE

Mcr: MAXIMUM CREDIBLE EARTHQUAKE

P-100%: PROBABILITY (POISSON DISTRIBUTION) OF Mcr OCCURRENCE IN 100 YEARS

SLIP RATE: FAULT SLIP RATE, WESNOUSKY (1986)

LIST OF THE FAULTS CONSIDERED FOR THIS ANALYSIS

No	FAULT	M1	Mcr	P-100%	SLIP RATE mm/Yr
1	SAN ANDREAS (CARRIZO)	4.5	8.0	30.1	34.0
2	SAN ANDREAS (MOJAVE)	4.5	7.5	77.2	30.0
3	SAN ANDREAS (SAN BERNARDINO Mn	4.5	7.5	77.2	24.0
4	PALOS VERDES	4.5	7.0	3.1	.7
5	ELSINORE-A	4.5	7.1	16.7	4.0
6	WHITTIER	4.5	7.3	12.6	4.0
7	NEWPORT INGLEWOOD-A	4.5	6.8	6.9	1.0
8	NEWPORT INGLEWOOD-B	4.5	6.9	6.2	1.9
9	OFFSHORE NEWPORT INGLEWOOD FA	4.5	6.8	6.2	?
10	SANTA MONICA	4.5	6.7	2.4	.3
11	RAYMOND	4.5	6.7	3.1	.2
12	OAKRIDGE	4.5	6.9	17.4	3.5
13	SAN FERNANDO	4.5	6.5	39.4	?
14	SIERRA MADRE-A	4.5	6.4	2.4	?
15	SIERRA MADRE-B	4.5	6.5	2.4	4.0
16	SIERRA MADRE-C	4.5	6.5	2.4	?
17	SIERRA MADRE-D	4.5	6.4	2.4	?
18	SIERRA MADRE-E	4.5	6.4	2.4	?
19	CUCAMONGA	4.5	6.6	13.3	6.4
20	SAN JACINTO (LYTLE CREEK-CLARE	4.5	7.0	61.0	10.0
21	SANTA SUSANA	4.5	6.9	14.7	4.5
22	ARROYO PARIDA	4.5	7.0	1.6	.4
23	SAN CAYETANO	4.5	7.1	20.6	5.0
24	SANTA YNEZ (EAST)	4.5	7.3	3.1	1.0
25	BIG PINE	4.5	7.2	3.9	1.0
26	SAN GABRIEL-A	4.5	7.0	3.1	.6
27	SAN GABRIEL-B	4.5	6.7	5.4	.6
28	HOLLYWOOD	4.5	6.4	6.2	.8
29	VERDUGO	4.5	6.7	6.2	?

Figure III-1

RESULTS BASED ON CAMPBELL (1988) ATTENUATION EQUATION

PROBABILITY % OF PGA EXCEEDENCE IN 100 YEARS										
FAULT #	PEAK GROUND ACCELERATION g									
	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
1	15.6	2.6	.6	.2	.1	.0	.0	.0	.0	.0
2	54.4	11.7	2.8	.8	.2	.1	.0	.0	.0	.0
3	6.1	.4	.0	.0	.0	.0	.0	.0	.0	.0
4	1.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
5	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
6	7.8	1.0	.2	.1	.0	.0	.0	.0	.0	.0
7	14.3	2.8	.8	.3	.1	.0	.0	.0	.0	.0
8	1.0	.1	.0	.0	.0	.0	.0	.0	.0	.0
9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10	10.6	3.8	1.6	.7	.4	.2	.1	.1	.0	.0
11	3.8	.7	.2	.1	.0	.0	.0	.0	.0	.0
12	1.3	.1	.0	.0	.0	.0	.0	.0	.0	.0
13	94.0	57.8	26.8	12.2	5.7	2.8	1.5	.8	.4	.3
14	5.6	1.4	.5	.2	.1	.0	.0	.0	.0	.0
15	12.0	4.3	1.7	.7	.4	.2	.1	.0	.0	.0
16	4.1	.9	.3	.1	.0	.0	.0	.0	.0	.0
17	.5	.1	.0	.0	.0	.0	.0	.0	.0	.0
18	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
19	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0
20	2.0	.1	.0	.0	.0	.0	.0	.0	.0	.0
21	53.3	13.9	4.4	1.6	.7	.3	.2	.1	.0	.0
22	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
23	3.4	.3	.0	.0	.0	.0	.0	.0	.0	.0
24	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0
25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26	.8	.1	.0	.0	.0	.0	.0	.0	.0	.0
27	9.1	2.1	.7	.3	.1	.0	.0	.0	.0	.0
28	27.7	11.8	5.1	2.4	1.2	.6	.3	.2	.1	.1
29	59.3	44.1	29.3	18.6	11.7	7.4	4.7	3.1	2.0	1.4
ALL FAULTS	99.9	87.4	57.4	33.7	19.4	11.4	6.8	4.2	2.7	1.8

Figure III-2

PROBABILITY % OF PGA EXCCEDANCE IN DIFFERENT TIME PERIODS

YEARS

PEAK GROUND ACCELERATION g

	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
10	49.4	18.7	8.2	4.0	2.1	1.2	.7	.4	.3	.2
20	74.4	33.9	15.7	7.9	4.2	2.4	1.4	.9	.5	.4
30	87.1	46.3	22.6	11.6	6.3	3.6	2.1	1.3	.8	.5
40	93.4	56.3	28.9	15.1	8.3	4.7	2.8	1.7	1.1	.7
50	96.7	64.5	34.8	18.5	10.2	5.9	3.5	2.1	1.4	.9
60	98.3	71.1	40.1	21.8	12.1	7.0	4.2	2.6	1.6	1.1
70	99.2	76.5	45.0	25.0	14.0	8.1	4.8	3.0	1.9	1.2
80	99.6	80.9	49.5	28.0	15.8	9.2	5.5	3.4	2.2	1.4
90	99.8	84.5	53.6	30.9	17.6	10.3	6.2	3.8	2.4	1.6
100	99.9	87.4	57.4	33.7	19.4	11.4	6.8	4.2	2.7	1.8

DESIGN PEAK GROUND ACCELERATION VALUES AND THE EXPECTED DURATION

PROBABILITY % OF PGA EXCEEDENCE IN 100 YEARS

	63.4	39.4	18.1	9.5
ANNUAL RISK	.10E-01	.50E-02	.20E-02	.10E-02
PEAK GROUND ACCELERATION g	.28	.37	.51	.63
EXPECTED DURATION SECONDS	16	16	16	16

Figure III-3

RESULTS BASED ON JOYNER & BOORE (1981) ATTENUATION EQUATION

PROBABILITY % OF PGA EXCEEDENCE IN 100 YEARS

FAULT #	PEAK GROUND ACCELERATION g									
	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
1	22.3	2.3	.4	.1	.0	.0	.0	.0	.0	.0
2	82.8	14.9	3.0	.8	.2	.0	.0	.0	.0	.0
3	6.1	.3	.0	.0	.0	.0	.0	.0	.0	.0
4	4.4	.3	.1	.0	.0	.0	.0	.0	.0	.0
5	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0
6	27.2	2.1	.3	.1	.0	.0	.0	.0	.0	.0
7	28.3	6.0	1.6	.5	.2	.1	.0	.0	.0	.0
8	3.2	.2	.0	.0	.0	.0	.0	.0	.0	.0
9	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
10	12.8	4.9	2.0	.9	.5	.2	.1	.1	.0	.0
11	8.4	1.6	.4	.1	.0	.0	.0	.0	.0	.0
12	4.2	.2	.0	.0	.0	.0	.0	.0	.0	.0
13	96.8	69.2	35.4	16.8	8.1	4.1	2.0	1.1	.6	.3
14	8.2	2.4	.8	.3	.1	.1	.0	.0	.0	.0
15	13.6	5.4	2.2	1.0	.5	.2	.1	.1	.0	.0
16	7.3	1.7	.5	.2	.1	.0	.0	.0	.0	.0
17	1.6	.2	.0	.0	.0	.0	.0	.0	.0	.0
18	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0
19	.9	.0	.0	.0	.0	.0	.0	.0	.0	.0
20	4.4	.1	.0	.0	.0	.0	.0	.0	.0	.0
21	76.5	26.8	8.6	3.2	1.2	.5	.2	.1	.1	.0
22	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
23	7.3	.5	.1	.0	.0	.0	.0	.0	.0	.0
24	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0
25	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
26	2.1	.2	.0	.0	.0	.0	.0	.0	.0	.0
27	15.8	3.9	1.2	.4	.2	.1	.0	.0	.0	.0
28	30.0	13.2	5.7	2.6	1.3	.7	.4	.2	.1	.1
29	56.7	35.2	19.4	10.6	6.0	3.5	2.1	1.3	.9	.5
ALL FAULTS	100.0	92.4	60.7	32.9	17.3	9.3	5.1	2.9	1.7	1.0

Figure III-4

PROBABILITY % OF PGA EXCCEDANCE IN DIFFERENT TIME PERIODS

YEARS

PEAK GROUND ACCELERATION g

	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
10	64.1	22.8	8.9	3.9	1.9	1.0	.5	.3	.2	.1
20	87.1	40.3	17.0	7.7	3.7	1.9	1.0	.6	.4	.2
30	95.4	53.9	24.4	11.3	5.5	2.9	1.5	.9	.5	.3
40	98.3	64.4	31.2	14.8	7.3	3.8	2.1	1.2	.7	.4
50	99.4	72.5	37.3	18.1	9.0	4.8	2.6	1.5	.9	.5
60	99.8	78.8	42.9	21.3	10.7	5.7	3.1	1.8	1.1	.6
70	99.9	83.6	48.0	24.4	12.4	6.6	3.6	2.0	1.2	.7
80	100.0	87.3	52.6	27.4	14.1	7.5	4.1	2.3	1.4	.8
90	100.0	90.2	56.9	30.2	15.7	8.4	4.6	2.6	1.6	.9
100	100.0	92.4	60.7	32.9	17.3	9.3	5.1	2.9	1.7	1.0

DESIGN PEAK GROUND ACCELERATION VALUES AND THE EXPECTED DURATION

	PROBABILITY % OF PGA EXCEEDENCE IN 100 YEARS			
	63.4	39.4	18.1	9.5
ANNUAL RISK	.10E-01	.50E-02	.20E-02	.10E-02
PEAK GROUND ACCELERATION g	.29	.37	.49	.60
EXPECTED DURATION SECONDS	16	16	17	17

Figure III-5

B. PROBABILISTIC GROUND MOTION ANALYSIS

SPECIAL CONSIDERATION FOR VERDUGO AND HOLLYWOOD REVERSE FAULTING

PROBABILISTIC GROUND MOTION ANALYSIS

SPECIAL CONSIDERATION FOR VERDUGO AND HOLLYWOOD REVERSE FAULTING
COORDINATES: LAT = 34.18 LONG = 118.34

M1: LOWER BOUND MAGNITUDE

Mcr: MAXIMUM CREDIBLE EARTHQUAKE

P-100%: PROBABILITY (POISSON DISTRIBUTION) OF Mcr OCCURRENCE IN 100 YEARS

SLIP RATE: FAULT SLIP RATE, WESNOUSKY (1986)

LIST OF THE FAULTS CONSIDERED FOR THIS ANALYSIS

No	FAULT	M1	Mcr	P-100%	SLIP RATE mm/Yr
1	SAN ANDREAS (CARRIZO)	4.5	8.0	30.1	34.0
2	SAN ANDREAS (MOJAVE)	4.5	7.5	77.2	30.0
3	SAN ANDREAS (SAN BERNARDINO Mn	4.5	7.5	77.2	24.0
4	PALOS VERDES	4.5	7.0	3.1	.7
5	ELSINORE-A	4.5	7.1	16.7	4.0
6	WHITTIER	4.5	7.3	12.6	4.0
7	NEWPORT INGLEWOOD-A	4.5	6.8	6.9	1.0
8	NEWPORT INGLEWOOD-B	4.5	6.9	6.2	1.9
9	OFFSHORE NEWPORT INGLEWOOD FA	4.5	6.8	6.2	?
10	SANTA MONICA	4.5	6.7	2.4	.3
11	RAYMOND	4.5	6.7	3.1	.2
12	OAKRIDGE	4.5	6.9	17.4	3.5
13	SAN FERNANDO	4.5	6.5	39.4	?
14	SIERRA MADRE-A	4.5	6.4	2.4	?
15	SIERRA MADRE-B	4.5	6.5	2.4	4.0
16	SIERRA MADRE-C	4.5	6.5	2.4	?
17	SIERRA MADRE-D	4.5	6.4	2.4	?
18	SIERRA MADRE-E	4.5	6.4	2.4	?
19	CUCAMONGA	4.5	6.6	13.3	6.4
20	SAN JACINTO (LYTLE CREEK-CLARE	4.5	7.0	61.0	10.0
21	SANTA SUSANA	4.5	6.9	14.7	4.5
22	ARROYO PARIDA	4.5	7.0	1.6	.4
23	SAN CAYETANO	4.5	7.1	20.6	5.0
24	SANTA YNEZ (EAST)	4.5	7.3	3.1	1.0
25	BIG PINE	4.5	7.2	3.9	1.0
26	SAN GABRIEL-A	4.5	7.0	3.1	.6
27	SAN GABRIEL-B	4.5	6.7	5.4	.6
28	HOLLYWOOD	4.5	6.4	6.2	.8
29	VERDUGO	4.5	6.7	6.2	?

Figure III-6

RESULTS BASED ON CAMPBELL (1988) ATTENUATION EQUATION

PROBABILITY % OF PGA EXCEEDENCE IN 100 YEARS

FAULT #	PEAK GROUND ACCELERATION g									
	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
1	15.6	2.6	.6	.2	.1	.0	.0	.0	.0	.0
2	54.4	11.7	2.8	.8	.2	.1	.0	.0	.0	.0
3	6.1	.4	.0	.0	.0	.0	.0	.0	.0	.0
4	1.2	.1	.0	.0	.0	.0	.0	.0	.0	.0
5	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
6	7.8	1.0	.2	.1	.0	.0	.0	.0	.0	.0
7	14.3	2.8	.8	.3	.1	.0	.0	.0	.0	.0
8	1.0	.1	.0	.0	.0	.0	.0	.0	.0	.0
9	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
10	10.6	3.8	1.6	.7	.4	.2	.1	.1	.0	.0
11	3.8	.7	.2	.1	.0	.0	.0	.0	.0	.0
12	1.3	.1	.0	.0	.0	.0	.0	.0	.0	.0
13	94.0	57.8	26.8	12.2	5.7	2.8	1.5	.8	.4	.3
14	5.6	1.4	.5	.2	.1	.0	.0	.0	.0	.0
15	12.0	4.3	1.7	.7	.4	.2	.1	.0	.0	.0
16	4.1	.9	.3	.1	.0	.0	.0	.0	.0	.0
17	.5	.1	.0	.0	.0	.0	.0	.0	.0	.0
18	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
19	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0
20	2.0	.1	.0	.0	.0	.0	.0	.0	.0	.0
21	53.3	13.9	4.4	1.6	.7	.3	.2	.1	.0	.0
22	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
23	3.4	.3	.0	.0	.0	.0	.0	.0	.0	.0
24	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0
25	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
26	.8	.1	.0	.0	.0	.0	.0	.0	.0	.0
27	9.1	2.1	.7	.3	.1	.0	.0	.0	.0	.0
28	34.8	20.5	11.3	6.4	3.7	2.2	1.4	.9	.6	.4
29	62.6	54.2	43.4	33.0	24.4	17.8	12.9	9.4	6.9	5.1
ALL FAULTS	99.9	90.7	68.2	47.6	32.8	22.6	15.7	11.1	7.9	5.8

Figure III-7

PROBABILITY % OF PGA EXCCEDANCE IN DIFFERENT TIME PERIODS

YEARS

PEAK GROUND ACCELERATION g

	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
10	50.4	21.2	10.8	6.3	3.9	2.5	1.7	1.2	.8	.6
20	75.4	37.9	20.5	12.1	7.6	5.0	3.4	2.3	1.6	1.2
30	87.8	51.0	29.1	17.6	11.2	7.4	5.0	3.5	2.5	1.8
40	94.0	61.4	36.7	22.8	14.7	9.7	6.6	4.6	3.3	2.3
50	97.0	69.6	43.6	27.6	18.0	12.0	8.2	5.7	4.1	2.9
60	98.5	76.0	49.7	32.2	21.2	14.3	9.8	6.8	4.8	3.5
70	99.3	81.1	55.1	36.4	24.3	16.4	11.3	7.9	5.6	4.1
80	99.6	85.1	60.0	40.4	27.2	18.5	12.8	9.0	6.4	4.6
90	99.8	88.2	64.3	44.1	30.0	20.6	14.3	10.1	7.2	5.2
100	99.9	90.7	68.2	47.6	32.8	22.6	15.7	11.1	7.9	5.8

DESIGN PEAK GROUND ACCELERATION VALUES AND THE EXPECTED DURATION

PROBABILITY % OF PGA EXCEEDENCE IN 100 YEARS

	63.4	39.4	18.1	9.5
ANNUAL RISK	.10E-01	.50E-02	.20E-02	.10E-02
PEAK GROUND ACCELERATION g	.32	.45	.66	.84
EXPECTED DURATION SECONDS	16	16	16	16

Figure III-8

RESULTS BASED ON JOYNER & BOORE (1981) ATTENUATION EQUATION

PROBABILITY % OF PGA EXCEEDENCE IN 100 YEARS

FAULT #	PEAK GROUND ACCELERATION g									
	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
1	22.3	2.3	.4	.1	.0	.0	.0	.0	.0	.0
2	82.8	14.9	3.0	.8	.2	.0	.0	.0	.0	.0
3	6.1	.3	.0	.0	.0	.0	.0	.0	.0	.0
4	4.4	.3	.1	.0	.0	.0	.0	.0	.0	.0
5	.2	.0	.0	.0	.0	.0	.0	.0	.0	.0
6	27.2	2.1	.3	.1	.0	.0	.0	.0	.0	.0
7	28.3	6.0	1.6	.5	.2	.1	.0	.0	.0	.0
8	3.2	.2	.0	.0	.0	.0	.0	.0	.0	.0
9	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
10	12.8	4.9	2.0	.9	.5	.2	.1	.1	.0	.0
11	8.4	1.6	.4	.1	.0	.0	.0	.0	.0	.0
12	4.2	.2	.0	.0	.0	.0	.0	.0	.0	.0
13	96.8	69.2	35.4	16.8	8.1	4.1	2.0	1.1	.6	.3
14	8.2	2.4	.8	.3	.1	.1	.0	.0	.0	.0
15	13.6	5.4	2.2	1.0	.5	.2	.1	.1	.0	.0
16	7.3	1.7	.5	.2	.1	.0	.0	.0	.0	.0
17	1.6	.2	.0	.0	.0	.0	.0	.0	.0	.0
18	.4	.0	.0	.0	.0	.0	.0	.0	.0	.0
19	.9	.0	.0	.0	.0	.0	.0	.0	.0	.0
20	4.4	.1	.0	.0	.0	.0	.0	.0	.0	.0
21	76.5	26.8	8.6	3.2	1.2	.5	.2	.1	.1	.0
22	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
23	7.3	.5	.1	.0	.0	.0	.0	.0	.0	.0
24	.3	.0	.0	.0	.0	.0	.0	.0	.0	.0
25	.1	.0	.0	.0	.0	.0	.0	.0	.0	.0
26	2.1	.2	.0	.0	.0	.0	.0	.0	.0	.0
27	15.8	3.9	1.2	.4	.2	.1	.0	.0	.0	.0
28	33.6	17.5	8.6	4.4	2.3	1.3	.8	.5	.3	.2
29	59.7	42.2	26.2	15.8	9.6	6.0	3.8	2.5	1.7	1.2
ALL FAULTS	100.0	93.6	65.2	38.0	21.3	12.2	7.1	4.3	2.7	1.8

Figure III-9

PROBABILITY % OF PGA EXCCEDANCE IN DIFFERENT TIME PERIODS

YEARS	PEAK GROUND ACCELERATION g									
	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00
10	64.6	24.1	10.0	4.7	2.4	1.3	.7	.4	.3	.2
20	87.5	42.3	19.0	9.1	4.7	2.6	1.5	.9	.5	.4
30	95.6	56.2	27.1	13.4	6.9	3.8	2.2	1.3	.8	.5
40	98.4	66.7	34.4	17.4	9.1	5.1	2.9	1.7	1.1	.7
50	99.4	74.7	41.0	21.2	11.3	6.3	3.6	2.2	1.4	.9
60	99.8	80.8	46.9	24.9	13.4	7.5	4.3	2.6	1.6	1.1
70	99.9	85.4	52.2	28.4	15.4	8.7	5.0	3.0	1.9	1.2
80	100.0	88.9	57.0	31.8	17.4	9.8	5.7	3.5	2.2	1.4
90	100.0	91.6	61.3	34.9	19.4	11.0	6.4	3.9	2.4	1.6
100	100.0	93.6	65.2	38.0	21.3	12.2	7.1	4.3	2.7	1.8

DESIGN PEAK GROUND ACCELERATION VALUES AND THE EXPECTED DURATION

	PROBABILITY % OF PGA EXCEEDENCE IN 100 YEARS			
	63.4	39.4	18.1	9.5
ANNUAL RISK	.10E-01	.50E-02	.20E-02	.10E-02
PEAK GROUND ACCELERATION g	.30	.39	.53	.64
EXPECTED DURATION SECONDS	16	16	16	17

Figure III-10

APPENDIX IV

DETERMINISTIC SEISMIC PARAMETER ANALYSIS; A HYPOTHETICAL SITE IN THE CITY OF BURBANK

Deterministic Seismic Parameter Analysis

A hypothetical site in the city of Burbank

Site Latitude = 34.1800, Site Longitude = 118.3400

List of Variables

- L: Length of the fault in km (9,11,12)
X: Shortest distance from the site to the fault in km
Mcr: Magnitude of the Maximum Credible earthquake (9,4)
Tr: The expected return period for the Maximum Credible earthquake (9,4)
Y1: Horizontal peak ground acceleration, Campbell (1988) (2)
Y2: Horizontal peak ground acceleration, Joyner & Boore (1981) (7)
Y3: Horizontal peak ground acceleration(deep soil site), Idriss (1987) (4)
Y4: Similar to Y3 but for a rock or shallow stiff soil site (4)
D: Expected duration in seconds (3,10)
Per: Expected predominant period of the ground motion in seconds (8)

	L km	X km	Mcr	Tr Years	Y1 g	Y2 g	Y3 g	Y4 g	D SEC	PER SEC
SAN ANDREAS(CARRIZO)	145	53	8.0	300	.14	.12	.15	.16	50	.40
SAN ANDREAS(MOJAVE)	107	46	7.5	160	.12	.11	.13	.14	35	.35
SAN ANDREAS(SAN BERNARDINO Mnts)	110	77	7.5	200	.06	.05	.08	.08	35	.35
SAN ANDREAS(COACHELLA VALLEY)	112	170	7.5	260	.02	.01	.04	.03	35	.35
SA/Mojave-San Bernardino	217	46	8.0	160	.16	.14	.17	.18	50	.40
SA/Coachella-San Bernardino	222	77	8.0	260	.09	.07	.11	.11	50	.40
PALOS VERDES	45	34	7.0	2900	.12	.12	.13	.14	25	.31
CHINO	28	63	6.8	?	.05	.05	.06	.06	22	.30
ELSINORE-A	51	89	7.1	550	.04	.04	.05	.05	27	.32
WHITTIER	74	36	7.3	730	.13	.13	.15	.15	31	.33
NEWPORT INGLEWOOD-A	28	17	6.8	1450	.21	.22	.21	.24	22	.30
NEWPORT INGLEWOOD-B	34	42	6.9	1650	.09	.09	.11	.10	24	.30
OFFSHORE NEWPORT INGLEWOOD	29	80	6.8	?	.03	.04	.05	.04	22	.30
SANTA MONICA	24	9	6.7	3960	.32	.34	.30	.35	21	.29
MALIBU COAST	34	23	6.9	?	.17	.18	.18	.19	24	.30
RAYMOND	22	21	6.7	3000	.16	.17	.18	.19	21	.29
OAKRIDGE	39	51	6.9	520	.07	.07	.09	.08	24	.30
SAN FERNANDO	17	10	6.5	200	.27	.29	.27	.30	19	.27
SIERRA MADRE-A	14	14	6.4	5000	.20	.21	.21	.23	18	.27

	L km	X km	Mcr	Tr Years	Y1 g	Y2 g	Y3 g	Y4 g	D SEC	PER SEC
SIERRA MADRE-B	17	9	6.5	5000	.29	.31	.28	.32	19	.27
SIERRA MADRE-C	15	16	6.5	5000	.19	.20	.20	.22	19	.27
SIERRA MADRE-D	14	29	6.4	5000	.09	.11	.12	.12	18	.27
SIERRA MADRE-E	14	47	6.4	5000	.05	.06	.07	.06	18	.27
CUCAMONGA	20	60	6.6	700	.04	.05	.06	.05	20	.28
SAN JACINTO(LYTLE CREEK-CLAREMONT)	78	67	7.0	110	.05	.05	.07	.06	25	.31
SANTA SUSANA	38	15	6.9	630	.24	.26	.24	.27	24	.30
ARROYO PARIDA	44	74	7.0	5350	.04	.04	.06	.06	25	.31
SAN CAYETANO	49	51	7.1	430	.08	.08	.10	.09	27	.32
SANTA YNEZ(EAST)	84	66	7.3	3200	.06	.06	.09	.08	31	.33
PINE MOUNTAIN	59	61	7.1	?	.06	.06	.08	.08	27	.32
BIG PINE	67	92	7.2	2700	.04	.04	.06	.05	29	.33
SAN GABRIEL-A	47	37	7.0	?	.11	.11	.12	.13	25	.31
SAN GABRIEL-B	24	16	6.7	?	.21	.22	.21	.24	21	.29
VERDUGO	26	3	6.7	?	.49	.50	.42	.52	21	.29
HOLLYWOOD	17	8	6.4	1630	.30	.31	.29	.33	18	.27

. Duration is based on interpretation of the work by Dobry (1978) and Trifunac (1975).

Predominant period is based on Seed (1969) result

Return period of Mcr earthquake is calculated assuming that the accumulated strain on the fault is released only by the Mcr earthquake

The estimated peak ground accelerations and velocities are for strike slip faults. For thrust and reverse faults Campbell recommends increasing the values by a factor of 1.4. Joyner and Boore do not recommend any correction for various faulting mechanisms

SEISMIC DESIGN PARAMETERS

The peak ground acceleration at this location, based on the average of the three relevant attenuation equations (i.e. $Y = [Y1 + Y2 + Y4]/3$), is estimated as .50 g. This ground motion is due to an earthquake of magnitude 6.7 on the VERDUGO fault at an epicentral distance of 3 km. This earthquake would cause 21 seconds of ground shaking with an expected predominant period of .29 second.

The expected maximum ground shaking duration at this site is 50 seconds due to an earthquake of magnitude 8.0 on the SA/Mojave-San Bernardino fault at an epicentral distance of 46 km. The peak acceleration for this earthquake would be .17 g, with an expected predominant period of .40 second.

Deterministic Seismic Parameter Analysis

A hypothetical site in the city of Burbunk
 Site Latitude = 34.1800, Site Longitude = 118.3400
 Vertical acceleration and horizontal velocity
 Depth to the bedrock type material 30 meters

List of Variables

L: Length of the fault in km (9,11,12)
 X: Shortest distance from the site to the fault in km
 Mcr: Magnitude of the Maximum Credible earthquake (9,4)
 Tr: The expected return period for the Maximum Credible earthquake (9,4)
 Y5: Vertical peak ground acceleration, Campbell (1989) (1)
 V1: Vertical peak ground velocity, Campbell (1989) (1)
 V2: Horizontal peak ground velocity, Campbell (1988) (2)
 V3: Horizontal peak ground velocity, Joyner and Boore (1981) (7)

	L km	X km	Mcr	Tr Years	Y5 g	V1 CM/S	V2 CM/S	V3 CM/S
SAN ANDREAS(CARRIZO)	145	53	8.0	300	.11	10.6	18.4	19.3
SAN ANDREAS(MOJAVE)	107	46	7.5	160	.09	7.5	13.2	13.2
SAN ANDREAS(SAN BERNARDINO Mnts)	110	77	7.5	200	.04	4.5	7.9	6.6
SAN ANDREAS(COACHELLA VALLEY)	112	170	7.5	260	.02	1.7	3.2	1.7
SA/Mojave-San Bernardino	217	46	8.0	160	.13	11.8	20.7	23.2
SA/Coachella-San Bernardino	222	77	8.0	260	.07	7.8	13.2	11.5
PALOS VERDES	45	34	7.0	2900	.08	5.8	10.8	10.9
CHINO	28	63	6.8	?	.03	2.2	4.5	4.0
ELSINORE-A	51	89	7.1	550	.03	2.2	4.3	3.4
WHITTIER	74	36	7.3	730	.10	7.6	13.8	14.3
NEWPORT INGLEWOOD-A	28	17	6.8	1450	.16	8.8	17.0	18.8
NEWPORT INGLEWOOD-B	34	42	6.9	1650	.06	4.1	7.8	7.5
OFFSHORE NEWPORT INGLEWOOD	29	80	6.8	?	.02	1.7	3.4	2.8
SANTA MONICA	24	9	6.7	3960	.28	12.8	25.5	31.2
MALIBU COAST	34	23	6.9	?	.12	7.5	14.3	15.2
RAYMOND	22	21	6.7	3000	.11	6.6	12.8	13.4
OAKRIDGE	39	51	6.9	520	.04	3.3	6.4	5.9
SAN FERNANDO	17	10	6.5	200	.22	10.2	20.3	22.6
SIERRA MADRE-A	14	14	6.4	5000	.14	7.0	14.0	14.6

	L km	X km	Mcr	Tr Years	Y5 g	V1 CM/S	V2 CM/S	V3 CM/S
SIERRA MADRE-B	17	9	6.5	5000	.24	11.0	22.0	24.9
SIERRA MADRE-C	15	16	6.5	5000	.13	6.9	13.6	14.3
SIERRA MADRE-D	14	29	6.4	5000	.06	3.3	6.7	6.7
SIERRA MADRE-E	14	47	6.4	5000	.03	1.8	3.9	3.7
CUCAMONGA	20	60	6.6	700	.03	1.8	3.7	3.4
SAN JACINTO(LYTLE CREEK-CLAREMONT)	78	67	7.0	110	.03	2.7	5.2	4.6
SANTA SUSANA	38	15	6.9	630	.19	10.6	20.5	24.0
ARROYO PARIDA	44	74	7.0	5350	.03	2.4	4.7	4.0
SAN CAYETANO	49	51	7.1	430	.05	4.3	7.9	7.4
SANTA YNEZ(EAST)	84	66	7.3	3200	.05	4.1	7.5	6.5
PINE MOUNTAIN	59	61	7.1	?	.04	3.5	6.5	5.8
BIG PINE	67	92	7.2	2700	.03	2.5	4.6	3.6
SAN GABRIEL-A	47	37	7.0	?	.07	5.3	9.9	9.8
SAN GABRIEL-B	24	16	6.7	?	.15	8.4	16.4	17.9
VERDUGO	26	3	6.7	?	.57	20.2	42.8	63.2
HOLLYWOOD	17	8	6.4	1630	.25	11.0	22.2	24.6

The estimated peak ground accelerations and velocities are for strike slip faults. For thrust and reverse faults Campbell recommends increasing the values by a factor of 1.4. Joyner and Boore do not recommend any correction for various faulting mechanisms

Peak horizontal velocities may be corrected for the site effect using a correction factor S

$$\log(S) = -0.45\log(V/1190)$$

where V is the average shear wave velocity (m/s) of the top 40 m of soil.

APPENDIX V

GLOSSARY OF TERMS FOR SEISMIC SAFETY HAZARD

GLOSSARY OF TERMS FOR SEISMIC SAFETY HAZARD

Abatement: The reduction or elimination of a hazardous condition, including but not limited to strengthening, occupancy restrictions or demolitions.

Acceptable Level: Acceptable level of risk means that level that provides reasonable protection of the public safety, though it does not necessarily ensure continued structural integrity and functionality of the project [California Code of Regulations (CCR) Section 3721(a)].

Active Fault: A fault that shows evidence of, or is suspected of having experienced surface displacement within the last 11,000 years. An active fault is considered to have the highest potential for future surface rupture.

Aftershocks: Earthquakes that follow a main larger earthquake, most commonly smaller than the main shock.

Alluvium: Surficial sediments of poorly consolidated gravels, sands, silts, and clays deposited by flowing water.

Bedrock: Hard rock that is in its natural intact position and underlies soil or other unconsolidated surficial material.

Critical Facilities: The following are categories of critical facilities referenced in this Element.

- Essential facilities that are needed in times of emergencies, such as medical facilities, fire and police stations, emergency operation centers and communication centers;
- High-risk facilities that, if severely damaged, could cause catastrophic casualties or disasters far beyond the facility itself, such as nuclear power plants, dams and flood control infrastructure, freeway-to-freeway interchanges and bridges, and industrial plants which manufacture or store explosives, toxic materials, or petroleum products;
- High occupancy facilities having potential for catastrophic fatalities and crowd control problems, such as high-rise buildings, large assembly public

and private facilities, and large multi-family residential complexes;

- Dependent care facilities that house populations with special evacuation considerations, such as educational facilities for preschool, public and private schools, rehabilitation centers, prisons and major social care facilities, including group care homes and elderly care facilities; and
- Economic facilities whose continued operation is paramount to avoiding severe economic impact, such as banking, vital record keeping, archiving activities, airport and port facilities, and large industrial/commercial complexes.

Deterministic: Synonymous with designating a maximum credible event for the seismic design of a structure.

Differential Settlement: Non-uniform settlement; the uneven lowering of different parts of an engineering structure, often resulting in damage to the structure. Sometimes included with liquefaction as ground failure phenomenon.

Dynamic Analyses: A complex earthquake-resistant engineering design technique (UBC, used for critical facilities) capable of modeling the entire frequency spectra, or composition, of ground motion. The method is used to evaluate the stability of a site or structure by considering the motion from any source on mass, such as that dynamic motion produced by machinery or a seismic event.

Earthquake: Vibratory motion propagating within the earth or along its surface caused by the abrupt release of strain from elastically deformed rock by displacement along a fault.

Engineering Geologist: A geologist who is certified by the state as qualified to apply geologic data, principles, and interpretation to naturally-occurring earth materials so that geologic factors affecting planning, design, construction, and maintenance of civil engineering works are properly recognized and used. An engineering geologist is particularly needed to conduct investigations, often with geotechnical engineers, of sites with potential ground failure hazards.

Fault: A fracture (rupture) or a zone of fractures along which there has been displacement of adjacent earth material.

Geotechnical Engineer: A licensed civil engineer who is also certified by the state as qualified for the investigation and engineering evaluation of earth materials and their interaction with earth retention systems, structural foundations, and other civil engineering works.

Geotechnical Report: A report prepared by a certified engineering geologist or a civil engineer practicing within the area of his/her competence, which identifies

seismic hazards and recommends mitigation measures to reduce the risk of seismic hazard to acceptable levels [PRC Section 2693(b)].

Ground Failure: Permanent ground displacement produced by fault rupture, differential settlement, liquefaction or slope failure.

Ground Rupture: Displacement of the earth's surface as a result of fault movement associated with an earthquake.

High Occupancy: High occupancy can be defined as exceeding 100, 200 and 500 person capacity, depending on importance factors of the facility, i.e., dependent care and other building uses.

Intensity: A subjective numerical measure of the effects of an earthquake at a particular place. Intensity depends on the earthquake magnitude, distance from the epicenter, and on the local geology, as well as on the subjective and/or empirical observations of damage in particular cultural setting, i.e., construction standards.

Lateral Force: The force of the horizontal side-to-side motion on the earth surface as measured on a particular mass, either a building or structure.

Lateral Spread: Shallow angle slope failure caused by liquefaction of a subsurface layer; very large displacement.

Lifeline System: Linear conduits or corridors for the delivery of services or movement of people and information (e.g., pipelines, telephones, freeways, railroads).

Liquefaction: Changing of soils (unconsolidated alluvium) from a solid state to weaker state unable to support structures where the material behaves similar to a liquid as a consequence of earthquake shaking.

Magnitude: A measure of the size of an earthquake, as determined by measurements from seismographic records.

Major Earthquake: Capable of widespread, heavy damage up to 50+ miles from epicenter; generally in Magnitude range 6.5 to 7.0 or greater, but can be less, depending on rupture mechanism, depth of earthquake, and location relative to urban center, etc.

Mitigation: Those measures that are consistent with established practice and reduce seismic risk to "acceptable levels" [PRC Section 2693(c)].

Moderate Earthquake: Capable of causing considerable to severe damage, generally in the range of Magnitude 5.0 to 6.0 (Modified Mercalli Intensity <VI),

but highly dependent on rupture mechanism, depth of earthquake, and location relative to urban center, etc.

Near-Field Earthquake: Used to describe a local earthquake within approximately a few fault zone widths of fault which is characterized by high frequency wave forms that are destructive to above-ground utilities and short-period structures (less than two or three stories high).

Nonstructural Hazard: Fallen or broken interior or exterior building components such as stains, piping, windows, wall partitions, electrical conduits, lights, brick veneer, equipment, etc.

Parapet: The portion of any wall which extends above the roof line, or a wall that serves as a guard at the edge of a balcony or roof.

Peak Acceleration: The greatest amplitude of acceleration measured across a record left on an accelerogram.

Potentially Active Fault: A fault showing evidence of movement within the last two million years, but which has not been proven to have moved or not within the last 11,000 years; capable of generating damaging earthquakes.

Probabilistic Assessment: Seismic risk assessment that accounts for how often and how strongly the ground will shake from surrounding seismic sources. The designation of a maximum probable earthquake is probabilistic.

Reinforced Masonry: Masonry construction with steel reinforcement.

Response Spectra: The range of potentially damaging frequencies of a given earthquake applied to a specific site and for a particular building or structure.

Seismic Capacity: The measure of resistance of a structure to strong earthquake shaking, or seismic loading as commonly used when applying lateral forces to a structure.

Seismology: The study of earthquakes.

Site Amplification: An increase in the seismic signal amplitude within some frequency resulting from propagation through crust, topography, earth materials at the site, bedrock and alluvium contact, etc.

Strike-Slip Fault: A fault with a vertical to subvertical fault surface in three dimensions that displays evidence of horizontal and opposite displacement.

Structural Engineer: A licensed civil engineer certified by the state as qualified to design and supervise the construction of engineered structures.

Tilt-Up Wall: A poured concrete and steel reinforced wall raised or lifted into place and tied to other walls, and to the roof and floor.

Veneer: A covering layer of material for walls, which is attached to the wall, but not bound adequately so as to act with it during earthquake shaking.

Water Table: The upper surface of groundwater which saturates pores and fractures in rock or surficial earth materials.

APPENDIX VI

REFERENCES FOR SEISMIC SAFETY HAZARD (Section IV)

REFERENCES FOR SEISMIC SAFETY HAZARD (Section IV)

- Anderson, J. G., and Luco, J. E. "Parametric Study of Near-Field Ground Motions for Oblique-Slip and Dip-Slip Dislocation Models." *Seismological Society of America Bulletin* Vol. 73 (1983):45-57.
- Bay Area Regional Earthquake Preparedness Project. *BAREPP Network Earthquake Preparedness News* Vol. 2, No. 2 (1987).
- Bay Area Regional Earthquake Preparedness Project. 1986a. *Local Incentive Program: Case Studies, Federal Emergency Management Agency and Seismic Safety Commission Cooperative Agreement*. EMF-86-K-0253.
- Bay Area Regional Earthquake Preparedness Project 1986b. *Hazardous Buildings: Case Studies, Federal Emergency Management Agency Cooperative Agreement*. EMF-86-K-0253.
- Bay Area Regional Earthquake Preparedness Project. *Earthquake Hazard Mitigation at the Community Level, Workshop Curriculum Materials: Spangle and Associates and the Reitherman Company*, Cooperative Agreement No. EMG-85-K-0227 (1985):54.
- Benuska, Lee, editor. "Loma Prieta Earthquake Reconnaissance Report." *Earthquake Spectra*, Supplement to Volume 6. 1990.
- California Department of Water Resources. *Statutes and Regulations Pertaining to Supervision of Dams and Reservoirs: Division of Safety of Dams*, 1986.
- California Department of Water Resources. *Dams within the Jurisdiction of the State of California: Department of Water Resources*. Bulletin 17-84, 1984.
- California Division of Mines and Geology. *Reconnaissance Seismic Hazards Map of the Burbank 7.5 minute Quadrangle, Los Angeles, California*. Open File Report 96-01, Reconnaissance Seismic Hazards Maps of Portions of Los Angeles and Ventura Counties, 1996.

California Public Interest Group. *Toxic Hazards in Los Angeles; a Report by CALPRIG and TOXICS Action*, 1989.

Campbell, K. W. *Preliminary Report on Empirical Studies of Vertical Strong Ground Motion for the Diablo Canyon Site, California, Prepared for the U.S. Geological Survey, Report to the U.S. Nuclear Regulatory Commission*, January 1989.

Campbell, K. W. *Preliminary Report on Empirical Studies of Horizontal Strong Ground Motion for the Diablo Canyon Site, California, Prepared for the U. S. Geological Survey, Report to the U.S. Nuclear Regulatory Commission*, October 1988.

Davis, J., J. Bennett, G. Borchardt, J. Kahle, S. Rice, and M. Silva. *Earthquake Planning Scenario for a Magnitude 8.3 Earthquake on the San Andreas Fault in Southern California: California Department of Conservation, Division of Mines and Geology, Special Publication 60*, 1982.

Davis, R. E. "Probabilities of Large Earthquakes Occurring in California on the San Andreas Fault: U. S. Geological Survey, Open File Report 88-398." *Preliminary Report of the Working Group on Earthquake Probabilities*, 1988.

Deppe, K. "The Whittier Narrows, California Earthquake of October 1987-- Evaluation of strengthened and Unstrengthened Unreinforced Masonry in Los Angeles City: EEIR." *Earthquake Spectra*, Vol. 4, No. 1 (1988):157-180.

Dibblee, T. W., Jr. *Geologic Map of the Sunland and Burbank (North ½) 7.5 Minute Quadrangles*. Dibblee Geological Foundation Map DF-32, scale 1:24,000. 1991a.

Dibblee, T. W., Jr. *Geologic Map of the Hollywood and Burbank (South ½) 7.5 Minute Quadrangles*. Dibblee Geological Foundation Map DF-31, scale 1:24,000. 1991b.

Earthquake Engineering Research Institute. *Loma Prieta Earthquake, October 17, 1989, Preliminary Reconnaissance Report, National Science Foundation*, Grant No. CES8822367. Publication No. 89-03, 1989.

Earthquake Engineering Research Institute. *Reducing Earthquake Hazards: Lessons Learned from Earthquakes*. Publication No. 86-02, 1986.

Earthquake Engineering Research Institute. *Nonstructural Issues of Seismic Design and Construction*. Publication No. 84-04; 1984.

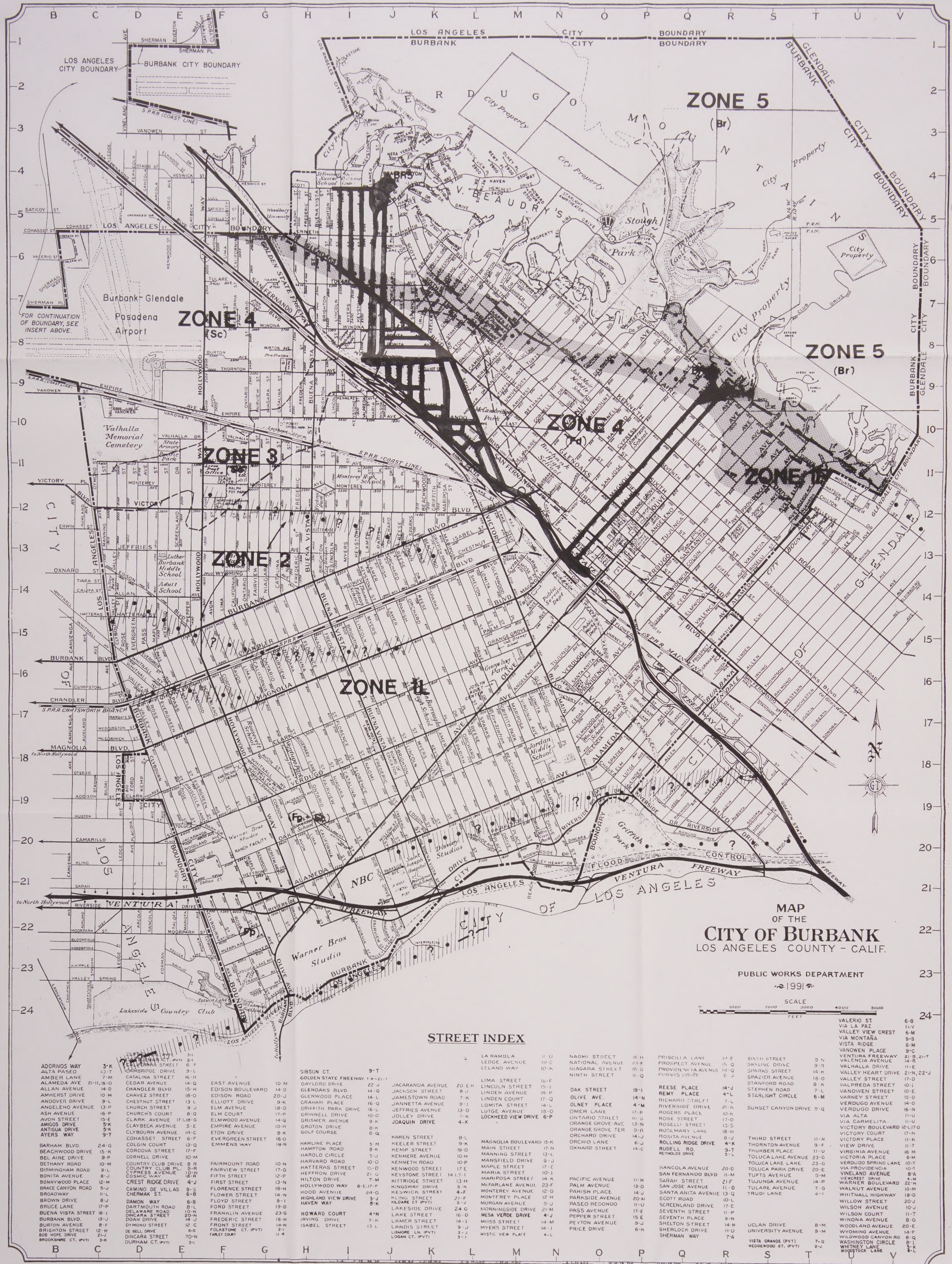
- Evernden, J., and J. Thomson. "Predicting Seismic Intensities." In: *Evaluating Earthquake Hazards in the Los Angeles Region, An Earth-Science Perspective*. Ed., J. I. Ziony. U.S. Geological Survey, Professional Paper 1360, 1985.
- Federal Emergency Management Agency. *Dam Safety: An Owner's Guidance Manual, Colorado Division of Disaster Emergency Services*. Comprehensive Cooperative Agreement #EMD-K-0089, 1987.
- Hays, E. *A Review of Information on Seismic Hazards Needed for the Earthquake-Resistant Design of Lifeline Systems in the United States*. U. S. Geological Survey, Open File Report ICSSCTR-10, 1988.
- Idriss, I. M. "Evaluation of Seismic Risk in Practice." *Proceedings of the 11th International Conference on Soils Mechanics and Foundation Engineering*, San Francisco. Vol 1 (1985): 255-270.
- Ishihara, K. "Stability of Natural Deposits During Earthquakes." *Proceedings of the 11th International Conference on Soils Mechanics and Foundation Engineering*, San Francisco. Vol 1 (1985): 321-376.
- Jaffe, M., J. Butler and C. Thurow. "Reducing Earthquake Risks." *A Planners Guide: American Planning Association, Planning Advisory Service*, Report No. 364, 1981.
- Joyner, W. B. and D. M. Boore. Estimate of Response--Special Values as a Function of Magnitude, Distance and Site Conditions. U. S. Geological Survey, Open File Report B2-881. 1982.
- Joyner, W. B. and D. M. Boore. "Peak Horizontal Acceleration and Velocity from Strong Motion Records Including Records from the 1979 Imperial Valley, California, Earthquake." *Seismology Society of America Bulletin*. Vol 71 (1981): 2011-2038.
- Joyner, W. B. and T. E. Fumal. "Predictive Mapping of Earthquake Ground Motion." In: *Evaluating Earthquake Hazards in the Los Angeles Region, An Earth-Science Perspective*. Ed., J. I. Ziony. U. S. Geological Survey, Professional Paper 1360, p. 203-217, 1985.
- Leighton and Associates, Inc. *Plate 1 of the Technical Database for the Revision of the City of Burbank Safety Element, Project No. 2891058-01*. Second draft (July 1990).
- Los Angeles County Transportation Commission. *Summary Report of County-Wide Assessment of Los Angeles Transportation Facilities*, Report Prepared by DeLeuw, Cather & Company, June 1990.

- National Council Earthquake Engineering Research. *Bulletin*. April (1989): 3-4.
- Palm, R. *Real Estate Agents and Special Studies Zone Disclosure; the Response of California Home Buyers to Earthquake Hazard Information*. University of Colorado at Boulder, Natural Hazards Research and Applications Information Center Monograph Series No. 32.
- Richter, C. F. *Elementary Seismology*. W. H. Freeman, San Francisco, 1958.
- Rogers, A. M., J. C. Tinsely and R. D. Borchardt. "Predicting Relative Ground Response". In: *Evaluating Earthquake Hazards in the Los Angeles Region, An Earth-Science Perspective*. Ed., J. I. Ziony. U. S. Geological Survey, Professional Paper 1360, p. 203-217, 1985.
- Roth, R., R. Holtom and S. Sai-on. *California Earthquake Zoning and Probable Maximum Loss Evaluation Program*. California Administrative Code Title 10, Chapter 5, Subchapter 3, Section 2307. California Department of Insurance, Los Angeles, California, 1986.
- Scawthorn, C. *Fire Following Earthquake, Estimates of the Conflagration Risk to Insured Property in Greater Los Angeles and San Francisco*. All Industry Research Advisory Council, Oak Brook, Illinois, 1987.
- Schiff, A. J. "The Whittier Narrows California Earthquake of October 1, 1987, Response of Lifelines and Their Effect on Emergency Response." *Earthquake Spectra*, Vol. 4, No. 2 (1988): 339-366.
- Seed, H. B. "Earthquake Resistant Design of Earth and Rock Fill Dams." *Geotechnique*, Vol. 29, No. 3 (1981): 215-263.
- Seed, H. B. "Soil Liquefaction and Cyclic Mobility Evaluation for Level Ground During Earthquakes." *Journal of the Geotechnical Engineering Division, ASCE*, Vol 105, No.GT2 (1979): 201-255.
- Seed, H. B., I. M. Idriss and L. Arango. "Evaluation of Liquefaction Potential Using Field Performance Data." *American Society of Civil Engineers Journal of Geotechnical Engineering Division*, Vol. 109, No. 3 (1983): 458-482.
- Seed, H. B., K. Tokimatsu, L. F. Harder and R. M. Chung. "Influence of SPT Procedures in Soil Liquefaction Resistance Evaluations." *Journal of the Geotechnical Engineering Division, ASCE*, Vol. II, No. 12, December (1985).
- Sharpe, R. *An Investigation of the Correlation between Earthquake Ground Motion and Building Performance*. Applied Technology Council, U.S. Contract Survey, No. 14-08-0001-19892, 1982.

- Sherburne, R. W. *Classification and Mapping Quaternary Sedimentary Deposits for Purposes of Seismic Zonation, South Coastal Los Angeles Basin, Orange County, California*. California Division of Mines and Geology, Open File Report 81-10, 1985.
- Spangle, W. E. *Putting Seismic Safety Policies to Work*. Prepared for the Bay Area Regional Earthquake Preparedness Project, 1988.
- State of California, Seismic Safety Commission. *Steps to Earthquake Safety for Local Governments*. Report No. SSC 88-01, 1988.
- State of California, Office of Planning and Research. *General Plan Guidelines*. 1987.
- State of California, Seismic Safety Commission. *Guidebook to Identify and Mitigate Seismic Hazards in Building*. Report No. SSC 87-03, 1987.
- Sudduth, C. "Evaluating Earthquake Ground Failure Potential for Development Decisions, Summary of Working Group V and Audience Discussion." In: *Future Directions in Evaluating Earthquake Hazards in the Los Angeles Region, An Earth-Science Perspective*. Ed., J. I. Ziony. U. S. Geological Survey, Professional Paper 1360, 1986.
- Tinsley, J. C., T. L. Youd, D. M. Perkins and A. T. F. Chen. "Evaluating Liquefaction Potential." In: *Evaluating Earthquake Hazards in the Los Angeles Region, An Earth-Science Perspective*. Ed., J. I. Ziony. U.S. Geological Survey, Professional Paper 1360, 1985.
- Tinsley, J. C. and T. E. Fumal. "Mapping Quaternary Sedimentary Deposits for Areal Variations in Shaking Response." In: *Evaluating Earthquake Hazards in the Los Angeles Region, An Earth-Science Perspective*. Ed., J. I. Ziony. U.S. Geological Survey, Professional Paper 1360, 1985.
- Topozada, T. R., J. H. Bennett, G. Borchardt, R. Saul and J. F. Davis. *Planning Scenario for a Major Earthquake on the Newport-Inglewood Fault Zone*. California Division of Mines and Geology, Special Publication 99, 1988.
- United State Geologic Survey. "Earthquake Hazards in Southern California." *Proceedings of Conference XXXII*, U. S. Geologic Survey, Open File Report 86-401, (1986): 158-172.
- Upper Los Angeles River Area Watermaster. *Ground-Water Contours for the Upper Los Angeles River Area*. 1993.

- Weber, F. H. "Geological Features Related to Character and Recency of Movement along Faults, North Central Los Angeles County." In: *Earthquake Hazards Associated with the Verdugo-Eagle Rock and Benedict Canyon Fault Zones, Los Angeles County, California*. Eds., F. H. Weber, Jr., J. H. Bennett, R. H. Chapman, G. W. Chase and R. B. Saul. California Division of Mines and Geology, Open File Report 80-10 LA, B1-B116, Plate 1, Scale 1:24,000, 1980.
- Wesnousky, S. G. "Earthquakes, Quaternary Faults, and Seismic Hazard in California." *Journal of Geophysical Research*, Vol. 91, No. B12 (1986): 12587-12631.
- Wolfe, M. R., P. A. Bolton, Heikkala, M. M. Greene, P. J. May. *Land-Use Planning for Earthquake Hazard Mitigation: A Handbook for Planners*. Natural Hazards Research and Applications Information Center, Special Publication 14, 1986.
- Youd, T. L. "Major Cause of Earthquake Damage is Ground Failure." *Civil Engineering*, Vol. 48, No. 4 (1978): 47-51.
- Ziony, J., ed. *Evaluating Earthquake Hazards in the Los Angeles Region, An Earth-Science Perspective*. U.S. Geological Survey, Professional Paper 1360, 1985.
- Ziony, J., et al. "Predicted Geologic and Seismologic Effects of a Postulated Magnitude 6.5 Rupture along the Northern Part of the Newport-Inglewood Zone." In: *Evaluating Earthquake Hazards in the Los Angeles Region, An Earth-Science Perspective*. Ed., J. I. Ziony. U.S. Geological Survey, Professional Paper 1360, 1985.
- Ziony, J. and L. Jones. *Map Showing Late Quaternary Faults and 1978 through 1984 Seismicity of the Los Angeles Region, California*. U. S. Geological Survey, MF 1964, Scale 1:250,000, 1989.

PLATE 1
City of Burbank Safety Element
SEISMIC HAZARD CONSTRAINTS



- EXPLANATION**
GEOLOGIC AND MAP SYMBOLS
- Active and potentially active faults: solid where their location is well established, dotted where concealed, and queried where location is uncertain or evidence is unequivocal.
 - Boundary separating different rock or soil materials.
 - Sc/Fp Fine-grained Stream Channel Deposits (Sc) and Stream Channel/Floodplain Deposits (Fp).
 - Fd Coarse-grained alluvial deposits.
 - Br Crystalline bedrock exposed in the hillsides.
 - BRS Approximate Dam Inundation Area (Example: BRS - Burbank Reservoir #5).
- HAZARD ZONES**
- Zone 1 Fault Rupture (Zone 1F) and Liquefaction-Hazard Zone (Zone 1L).
 - Zone 2 Potentially Active Faults.
 - Zone 3 Moderate susceptibility to liquefaction (historical high ground-water depths between 40 and 50 feet).
 - Zone 4 Low Susceptibility to Liquefaction.
 - Zone 5 High Susceptibility to Rock Falls, Landslides, and Areas with Seismically Unstable Slopes (for more detailed information about Seismically Unstable Slope Areas refer to CDWG, 1998).
 - Zone 6 Dam Inundation Areas; depicted by map pattern only.

Hazard Analysis and Management Checklist			
SCOPE OF SAFETY ELEMENT	RELATIVE RISK	CODE CONFORMANCE AND HAZARD MANAGEMENT	
LOCATION OF ZONE	SEISMIC HAZARD POTENTIAL	Low	High
City-Wide	Strong ground motion		
Zone 1	Fault Rupture Liquefaction (historical ground water up to 40 feet deep)		
Zone 2	Basin Faults		
Zone 3	Differential Settlement Liquefaction (historical ground water 40 to 50 feet deep)		
Zone 4	Differential Settlement Compaction		
Zone 5	Landslides / Rockfalls Unstable Out and Fill Slopes		
Zone 6	Dam Inundation		

* Special development requirements can include additional investigation (fault or liquefaction studies), site preparation, special foundations, structural redundancy, reinforced frames, etc. Hazard Reduction Features can include proactive or retroactive strengthening, special evaluation or emergency preparedness and planning requirements, emergency water supply, fire suppression capability, fire alarms, restricted use of hazardous materials, mitigation of unstable slopes along evacuation routes, etc. where appropriate for Critical Facilities, or where feasible.

Low severity profiles that the probability is low; public and private emergency preparedness planning should continue to be emphasized for dam inundation zones.

NOTES

- The liquefaction hazard zone includes those areas of the City underlain by susceptible sediments and where ground water has been reported within 40 feet of the ground surface (CDWG, 1998; Wells, 1998). Geotechnical studies to evaluate the potential for liquefaction are required in this area for all types of projects, in accordance with the Seismic Hazard Mapping Act of 1990 (California Public Resources Code Chapter 7.8, Division 2, effective April 1, 1991). Seasonal and long-term fluctuations in the shallow and perched water tables, possibly due to changes in ground-water management practices or successive seasons of anomalous rainfall or drought, may increase or decrease the hazard of liquefaction.
- Liquefaction has been known to occur at depths deeper than 50 feet if the right conditions are present. Therefore, the 50-foot depth ground-water contour is shown. The City could require that certain projects like high-occupancy and critical facility structures, if located between the 40- and 50-foot contour lines, address deeper liquefaction concerns in their geotechnical investigations.
- The liquefaction hazard zone comprises that area of the City where the potential for liquefaction is relatively high, and therefore, where ground failure could occur in future earthquakes. The zone does not predict whether or not liquefaction will occur in the area during an earthquake, nor does it predict the amount or direction of liquefaction-induced ground displacements. Site-specific geotechnical investigations are required in this zone to determine the potential for liquefaction-induced ground failure at a given site. The boundaries of the zone are based on smoothed, precise as depicted and should not be taken too literally. An owner may find it prudent to conduct geotechnical studies for liquefaction, even for projects outside of the regulated boundaries. Hazard reduction programs may be emphasized in these or other areas found to have a liquefaction hazard.
- The sediments in the northwestern portion of the City, in the area of the Burbank-Glendale-Pasadena airport, are susceptible to liquefaction if saturated. Historically, ground water in this area has been deeper than 40 feet; therefore, the area is not shown within the liquefaction hazard zone. However, should ground water ever rise in this area, a liquefaction hazard would develop.
- The hachure pattern across the Verdugo Fault designates a fault-liquefaction zone; the width of the shaded area does not preclude fault investigations outside of this area based on site-specific circumstances. The shaded area shown is intended only to ensure that adequate consideration is given to

- the fault rupture hazard, including fault trenching where feasible. It does not indicate the width of the fault itself.
- Faults with the diagonal-lined pattern in the basin areas are of uncertain activity (Weber et al., 1980). Risk cannot be readily established without expensive fault studies; project-specific circumstances may dictate the use of hazard reduction planning for projects involving critical facilities.
 - Dam-inundation areas are a direct compilation from maps developed in conformance with Section 8589.5 of the California Government Code. The code requires preparation of inundation maps and maintenance of emergency response and preparedness plans.
- References:**
- California Division of Mines and Geology, 1998, Preliminary Seismic Hazard Zone Map for the Burbank, California 7.5 Minute Quadrangle, Scale 1" = 4000', dated August 17, 1998.
 - California State Mining and Geology Board, 1997, Guidelines for Evaluation and Mitigation of Seismic Hazards in California, Chapter 4: Analysis and Mitigation of Liquefaction Hazards, Division of Mines and Geology Special Publication 117-79.
 - Weber, E.H., et al., 1980, Earthquake Hazards Associated with the Verdugo-Eagle Rock and Benedict Canyon Fault Zones, Los Angeles County, California, California Division of Mines and Geology Open File Report 80-11A.
 - Wells, Christopher J., 1998, Liquefaction Evaluation Report, Liquefaction Zones in the Burbank 7.5 Minute Quadrangle, Los Angeles County, California, California State Mining and Geology Board, California Division of Mines and Geology, unpublished report, 16p.

THIS MAP IS PART OF THE SAFETY ELEMENT OF THE CITY OF BURBANK GENERAL PLAN, AND SHOULD BE USED IN CONJUNCTION WITH THAT DOCUMENT AND THE TECHNICAL REPORTS UPON WHICH IT IS BASED.

Weber, F. H. "Geological Features Related to Character and Recent
 Movement along Faults, North Central Los Angeles County."
Hazards Associated with the Verdugo-Eagle Rock and Benning
Zones, Los Angeles County, California. Eds., F. H. Weber

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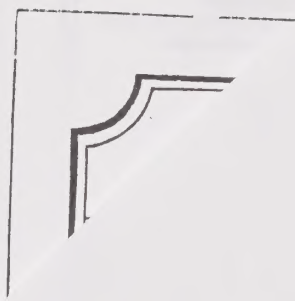
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